SCIENTIFIC AMERICAN

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THE WORLD'S COLUMBIAN EXPOSITION—THE FRENCH LOCOMOTIVE EXHIBIT—THE BETHLEHEM IRON CO.'S EXHIBIT.—[See p. 87.]

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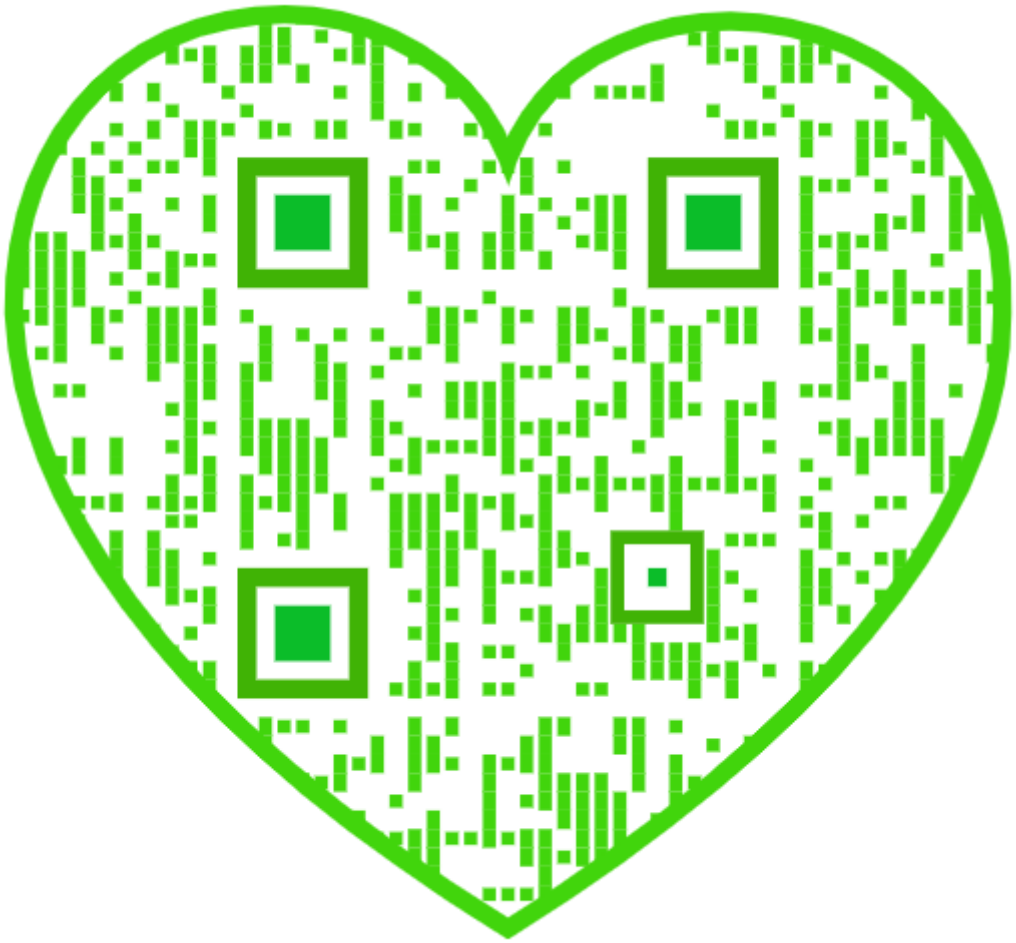

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THE EXPEDITION OF WORK IN THE PATENT OFFICE.

The new Commissioner of Patents, the Hon. John S. Seymour, deserves praise for his recent efforts to bring up to date the work now pending in the United States Patent Office. About May 1 he issued a circular letter to the examiners complaining of the condition of the work, especially upon the amended cases, and urging the bringing up of such cases either to date or to a period within ten days of date. As the effects of this letter were not apparent, on May 24 he issued Order No. 818, directing the same operation, and directing the examiners to give amended cases preference, even if it resulted in the falling behind of new cases. The general tendency of this, it will be seen, is to bring all pending matter more nearly up to an even level. In some of the examining divisions this order produced an excellent effect. To other divisions, where no considerable gain was apparent, the Commissioner wrote special letters calling attention to the above order, with the request for its observance. Probably one-half of the primary examiners received one of these special communications. Counting amended and new cases together, the Commissioner's efforts in the expedition of business since May 1, 1893, have been rewarded by a gain of probably 3,000 cases. A slight falling behind is noted at the middle of the present month, but this is due to the diminution of force in the office, owing to the taking of their annual vacations by the members of the examining corps.

RESUMPTION OF PUBLICATION OF THE PATENT OFFICE GAZETTE.

At last, after a considerable delay, the *Patent Office Gazette* may be said to have resumed publication. The issue dated July 4 is now out. In a few days we are promised the *Gazette* of July 11; the other *Gazettes* are to come out so that the issue of August 1 will be but a few days late, and unless some unforeseen accident occurs, the issues subsequent to August 1 are to appear on time. In the matter of the new contract we have ascertained the following facts: Last year the cost of printing of the official *Gazette* exceeded $56,000. The old contractor, when the time came for making tenders for the work, presented the same bid as before, although the amount appropriated was less than the estimated cost as calculated on the bid tendered by him. The new contractors have contracted that the aggregate cost of the *Gazette* will not exceed $45,000. This would indicate, if the proviso is carried out, a saving to the government of $11,000 per annum, which is something well worth considering. We have, however, before this, had occasion to remark on the excellence of the work exemplified by the old publication. We are sorry to say that the new one is of very far inferior character. This is so true that the saving even of $11,000 per annum could not for a moment be held to compensate for such pronounced inferiority both in the printing and the illustrating. In 1885 the work was taken from the old contractors for part of one issue, but the same company completed that issue and was eventually retained as the contractor. In a journal of such wide circulation as the *Patent Office Gazette*, there is one paramount interest to be considered, which is that of the public. Viewing the character of the printing and illustrating of the new *Gazette*, this interest now seems certainly overlooked, and the small and possibly uncertain economy does not justify the descent to a lower character of work.

THE EDISON ELECTRIC LIGHT SUITS.

A number of suits have within the past few years been brought by the owners of the Edison electric light patents against opposition companies, to enjoin the manufacture and use of incandescent electric lamps. Recently several decisions have been given by the courts, in which the general consensus of opinion was in favor of the Edison patent; but since the bringing of these suits new matter has been brought into the case and by special motions has been introduced into them. This matter is the claim of Henry Goebel, of this city, who is asserted to have anticipated Edison's inventions and to have made what is virtually an Edison lamp long before the date of Edison's invention or patent. Our readers will recollect that some months ago we published a description of Goebel's claims. The entire state of the case, both as regards the grounds on which the original Edison patent rests and as regards any modification of the scope of such patent brought about by the alleged Goebel structures, we find most ably presented in a decision handed down on July 20, by Judge Seamans, of the United States Circuit Court, sitting at Milwaukee.

The position that Edison occupies in the field of incandescent electric lighting is a peculiar one. The satisfactory subdivision of the electric light will be remembered by many as being one of the early difficulties encountered by the inventor in the early days of electric lighting. This difficulty was the most frequently quoted one. The use of incandescent carbon rods for electric lighting demanded a very heavy current with consequent increase of size of the conductors. This made electric lighting a commercial impossibility owing to the expense required for the street and house mains and wires. It was here that Edison appeared with his invention. In the famous second claim of his patent he claims "The combination of carbon filaments with a receiver made entirely of glass, and conductors passing through the glass and from which receiver the air is exhausted, for the purposes set forth." Here we have a high resistance lamp at once described, for, as electrical resistances go, a carbon filament could not, if made according to the patent, be of anything but high resistance. But a high resistance carbon filament is subject to disintegration and combustion by the smallest possible trace of air or carbonic acid gas. In the sealed glass globe is found the chamber in which a perfect vacuum can be conserved.

It is also perfectly true that to give this claim as wide scope under the patent statutes as the invention would seem to deserve is difficult. Edison in his early work on the incandescent lamp pursued his experiments under such conditions as to impart a peculiarly meritorious character to his investigations. The wizard of Menlo Park, as he was then called, exhibited his laboratory so freely and conducted his work so openly that he established for himself a very specific character as the inventor of the subdivision of the electric light. It is for this reason the decisions in his favor appear peculiarly consonant with the equities of the case, although it is impossible to stretch the law to cover the popular conception of his invention. In Judge Seamans' decision this peculiar status of Edison seems very satisfactorily recognized. The doubtful authenticity of the Goebel testimony is insisted on, the rejection of Goebel's claims by various inventors and counsel prior to the bringing of the suit is spoken of, and an injunction is granted in favor of the Edison Electric Light Company against the Oconto Company, against whom the suit was brought. This decision is granted in the face of a decision but three months old, to the opposite effect, rendered by Judge Hallett in the Eastern District of Missouri. Judge Hallett apparently considered the Goebel claims of such moment as to refuse the injunction, provided a bond was tendered by the defendants. It is hard to read Judge Seamans' decision without believing that it is he who has taken the right course, although he tempers it by granting leave to the defendants to move for the requirement of a bond by the complainants to indemnify the defendants for any damages they may suffer if the patent shall be finally declared invalid.

THE FALL IN THE VALUE OF GENERAL ELECTRIC STOCK.

The recent fall in the prices of all securities in Wall Street has been attended by a great decline in the value of the General Electric stock, which represents the consolidation of the Edison General and Thomson-Houston companies. Since last October the stock has fallen from 120 to 31¼; how much of this is due to panic and how much to any really valid estimate of the earning capacity of the company it is impossible to say. It is, however, something worthy of note, as the General Electric Company represents the leading electric syndicate of the country, and so phenomenal a change in the value of its stock in its relations to electrical development possesses a quasi-scientific import. It represents science and invention in Wall Street. The recent decisions in the Edison electric light case alluded to elsewhere have doubtless had their effect, as they have not been as sweepingly in favor as was to have been hoped. If the Goebel claims prove to be ill founded, it will seem that by their exploitation a great injustice has been done to investors in electric securities.

THE Engineers' Congress will be held during the week beginning July 31, and practically all of the arrangements for these congresses have been perfected. A large number of papers have already been handed in, and many more are promised in each division. Many of these papers will be presented in abstract, while others will be presented by title only. It would be quite impossible to conceive of a more attractive programme than this one, as papers will be presented by leading engineers, not only from all parts of the United States, but from all parts of the world, discussing leading engineering works of recent date. This is true of all the divisions, including mining engineering, metallurgical engineering, military engineering, mechanical engineering, etc. The subject of engineering education will have several meetings devoted to its consideration. Papers will be presented and discussed by leading teachers in engineering schools from all parts of the United States, as well as from Great Britain and elsewhere. The rooms of the Engineering Society at No. 10 Van Buren Street grow in popularity as their existence becomes more generally known, and the social meetings held Monday evenings have become an important event of the season with engineers in Chicago.

IN New York City there are so many railway lines, steam elevated, cable and horse cars, that one may ride for six hours at a total cost of 50 cents.

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In the Palace of Mechanic Arts at the World's Columbian Exposition the various exhibits in which the work of manufacture is carried on attract the greatest attention. They are many of these exhibits and they are always surrounded by interested audiences. The lookers-on appear even to begrudge the operatives the little time for lunch at noon, when the machinery is stopped. Most of these exhibits sell souvenirs that are made on the spot.

One of the most interesting of these exhibits is that of the Crown Fountain Pen Company, Chicago, which has in constant operation over a dozen machines illustrating the making of pens. The gold from which the pens are made is received in sheets, stamped, split and completed, even to the work of pointing with iridium points.

The manufacture of thimbles is shown by Simons Brothers & Co., of Philadelphia. The cups or blanks as they come in the rough from the press are finished in this exhibit. The operation of putting the many small indentations upon the thimble is called knurling, and one man can knurl about forty-five dozen thimbles a day. In addition to knurling, he smooths off the surface and ornaments, burnishes and finishes the thimble within and without.

The Knowles Loom Works, of Worcester, Mass., occupy a large space with a variety of looms, which are operated in weaving ribbons, worsted dress goods, silks, plain, figured and brocaded, carpeting, gingham and other fabrics. The Crompton Loom Works have a similar display, including a very wide loom which weaves rugs.

There are several exhibits in which silk badges, with pictures of Columbus, President or Mrs. Cleveland, as souvenirs are made; also figured silk handkerchiefs and other fabrics.

Schaum & Uhlinger, of Philadelphia, occupy a large space in which they weave these and other souvenirs and also weave silk cloth in a design and at the same time put over the groundwork figure another figure which gives the work an effect of hand embroidery.

Another interesting exhibit is that of the Star and Crescent Mills, of Philadelphia, by which Turkish toweling is made in various sizes, and young women operatives tie the knots in the fringes with surprising rapidity. As a comparison of new methods with old ones there is shown in this same exhibit a Turkish hand loom operated by a Turk, showing the slow and tedious manner in which this toweling was originally manufactured.

The Willimantic Thread Company occupy a large space with several machines. The thread is received here either in the hank or on bobbins. If in the hank, the thread is wound on bobbins and is rewound from these bobbins on spools. The spooler is an automatic machine, which requires only that the spools be fed into a trough and that the thread be fastened on the spool. The machine automatically takes the spools one at a time from the trough and, after the thread is fastened, winds until the spool is filled, then catches the thread, drops the spool into a receptacle, then takes up an empty spool and proceeds as before. Another machine pastes the labels on the ends of the spools, requiring no more attention than that of feeding the spools into a trough.

The Lowell Machine Shops, Lowell, Mass., illustrate the processes of weaving cotton cloth, beginning with the bale of cotton and ending with the finished cloth, marked, stamped and ready for market. The baled cotton is opened and the cotton run through the several operations from the picker through the spinning of the yarn, then is transferred to the looms and woven.

One of the most ingenious little devices exhibited is an electric engraving machine. The cutting point receives its energy in the form of rapid pulsations from the electricity, and if the operator is skillful in sketching, he need only take this tool in his hand and guide it according to the design he wishes to engrave; and the work is done nearly as quickly as a sketch could be made with a pencil. Souvenirs in variety are engraved while the purchaser waits.

Several manufacturers of sewing machines and embroidering machines make extensive exhibits of their machines in operation.

Several large printing presses, exhibited by the Chicago daily papers, run at specified times, printing papers at a speed of from 10,000 to 40,000 copies per hour. Crowds assemble every day to watch the starting of the printing presses.

Another incident that draws many spectators daily is the starting of the 2,000 horse power Allis engine, the king of the engine plant.

An innocent-looking machine shows a cylinder about four feet in diameter, the surface of which is roughly engraved with no ostensible intent or purpose. But when in operation a board of maple, whitewood, boxwood or almost any other wood, when fed into one end of the machine, comes out at the other end transformed into such a perfect imitation of quartered oak that only an experienced dealer would detect the manufactured article from the genuine.

Probably the largest machine tool shown in the Palace of Mechanic Arts is the planing machine exhibited by the Niles Tool Works Company. It weighs 270,000 pounds, and has a capacity for planing to the width of 144 inches and to a length of 32 feet or more. This is believed to be the largest planer ever built. A machine of this size is now used in the works of the General Electric Company, at Lynn, Mass. The table of this planer is one casting, weighing thirty-five tons. The machine is connected with the power plant of the Exposition, so that its working can be shown. The table returns at a speed three and one-half times greater than when it is feeding. By the use of an auxiliary attachment, which can be placed or adjusted on either side of the machine, a cutting width of 25 feet is afforded. This company also exhibits several other large machines, including a horizontal ten-foot boring and milling machine, a six-foot boring and turning mill, a 63 inch heavy forge turning lathe, and other machines.

In the Transportation building there is a most interesting exhibit from Germany, consisting of part of a plank road that was built by the Romans over a moor near Osnabrueck. It was a military road constructed across this moor ten and one-half miles long. It has been buried under moss all these centuries, but was uncovered last year from a depth of six feet of moss and other accumulation. The planks are quite badly decayed, but show faithfully the manner in which the road was constructed. Each plank seems to rest on the one ahead of it, and is pinned to the ground with a wooden pin eighteen inches or so long, passing through a hole in the plank at each end.

A tramway exhibit, also made by Germany, comprises a type of tramway that was used in the sixteenth century, and occasionally seen even at this day in some districts of Hungary. It presents a small wooden car of about two barrels capacity mounted on wheels which are but little larger than the hub of the wheel of an ordinary draught wagon. These wheels run on rails of wood laid about thirty inches apart. A switch forms part of the model. Crude as this model is, it reproduces completely the general plan upon which tramways are constructed at this day. Another exhibit reproduces the track of a tramway that was in use in Wales in 1776. The rails are a yard in length, and are of the angle rail type, having a guard of considerable height on the inside. The rails are of cast iron, fish-bellied. Each joint rests upon a roughly hewn stone about fifteen inches square. It was upon this road that Trevethick made an unsuccessful effort in 1804 to run an engine operated by steam.

Other models of tracks on this plan of construction are shown, each showing an improvement in some respect over those preceding it, until the modern method of railway construction is reached. The development of the modern railroad track with various modifications is followed down to the latest practice.

A collective exhibit of the products of the seven great Northwestern States traversed by the Northern Pacific Railroad Company is made by this company in a train of exhibit cars, which are fine specimens of car building and which are fitted up with an exceedingly attractive display of products of the Northwest. These cars were built at the shops of this railroad company and are vestibuled, and also have large bay windows on each side, reaching from the floor to the roof. The interior of the cars is ornamented with fancy woods from the forests in these States; also with grains and grasses. Large displays are made of ores and minerals of all kinds, building stones, and also the various products of the soil, including hops, flax, tobacco, etc. Each fruit in season is exhibited, showing the perfectness to which it reaches in these States, which are Wisconsin, Minnesota, North Dakota, Montana, Idaho, Washington, and Oregon. Many fine photographs of scenes along the route add much interest to the exhibit.

In the Palace of Mining, the Russell process of lixiviation for free and rebellious silver and silver-gold ores and tailings is well illustrated by a complete working model one-twentieth in size. This model illustrates a plant in operation which has a capacity of 125 tons. The entire operation of this process is demonstrated, from the placing of crushed ore in the vat to the recovering the metals and clarifying the chemicals.

The entire south gallery of the Mining building is occupied by the exhibit of American tin plate industries. It begins with samples of ore of the tin and of the iron from which the steel billets are made. Pig tin is shown that was mined in this country, being from the Temescal, California, mines. Many samples are shown, illustrating the various operations through which the metals pass before the plate is complete. Steel billets are shown in several stages of completeness up to the last stage, in which the sheet steel is ready for the dipping operation. Large sheets of American tin and also many samples of terne plates are shown, both singly and in cases. Coke, limestone, and other ingredients used in the operation of preparing tin add to the completeness of the exhibit. In the South Dakota exhibit, tin ore from the Harney's Peak mines is exhibited, and California makes further exhibits of tin in this building and also in its State building.

The H. C. Frick Coke Company, Connellsville, Pa., occupies a large space with models of coke ovens, samples of coke, and other accessories to the coke business. There is hardly a more practical and instructive exhibit than this. It shows a bank of sixty-four coke ovens in miniature, each oven complete in itself and being as natural as life by the use of illuminating gas, which is burning at all times. There is a superstructure over the shaft of a coal mine, with other necessary buildings to contain the engine and boiler plant, machine shop, etc. The engine plant is a perfect working model, so that by moving a small lever the engine is made to run, and the hoists which raise the coal up a shaft run up and down, fully explaining the manner in which the coal is raised from the mine to the bins overhead. The small cars, or larries, which convey the coal from the bins to the ovens, and which have a capacity sufficient to fill one oven, are run back and forth on a track between the double row of ovens. In front of the ovens are piles of coke, barrows, and railway tracks from which the coke is shipped directly from the ovens to market. Four model tenement houses, such as are built by this company for its miners, form part of this exhibit, which in reality represents only a small part of the Standard plant, which comprises 905 ovens. Another feature of this exhibit is a model bin and hoisting plant on a somewhat larger scale, which illustrates in somewhat more detail the manner in which coal is raised from the mine. This plant is of the most modern type, having a steel superstructure with all the latest appliances.

A large map of the United States, giving the location of each coal deposit in the country, and of every coal mine in operation, forms another exhibit. This map is 18×36 feet in size, and is stretched out on the floor under glass so as to be readily studied. Surrounding it are shelves filled with samples of coal, each numbered to correspond with numbers on the map, so that visitors at the Exposition who wish something more than the superficial view of this exhibit can see samples of coal from every mine in operation. Twenty-three States are represented in these samples. Another interesting exhibit from Pittsburg, Pa., shows the manner in which river steamers take big tows of barges of coal down the Ohio and Mississippi Rivers. This model represents a typical stern-wheel steamer with twenty barges in tow; each barge is supposed to represent a barge 130 feet long, 25 feet wide, and having a capacity of 13,000 bushels. At present tows are often twice the size of that represented, not infrequently as much as 20,000 tons being transported in one tow.

The exhibit made by religious organizations is in the northwestern corner of the gallery of the Palace of Manufactures and Liberal Arts. These exhibits are almost entirely of tracts and other church literature, together with portraits and photographs. The American Bible Society occupies one of the most advantageous booths, and displays Bibles in a large variety of bindings and sizes, from souvenirs of the Exposition to finely bound volumes. There are Bibles printed in 242 languages. Included among these is the Bible as just translated for the use of the natives in the Gilbert Islands, in the Pacific Ocean, representing the last work of translation of the society. A few of the historical Bibles owned by this society are shown, among them being pages from Eliot's Indian Bible, edition of 1685, and a copy of the first edition of the authorized version, printed in 1611. This is what is termed the King James version. There is also a fine reprint of the first book ever printed in which movable type was used. This bears date of 1450, and is the Scriptures in Latin. In one corner of the showcase is the "curiosity corner," containing a variety of articles that have been paid in exchange for copies of the Bible. The most highly prized article is a Chinese coin, which is believed to be 1850 years old.

Inside the north entrance of the Government building is the United States hatching exhibit. The last fish was hatched a month ago, and Mr. Day, by way of giving effective illustrations of the process of artificial fish culture, has had recourse to some very ingenious devices. There are various styles of hatching machines. Practically they are constructed on the same general principle. Perhaps the glass jar machine gives the most satisfactory results. As its name im-

(*Continued on page 86.*)

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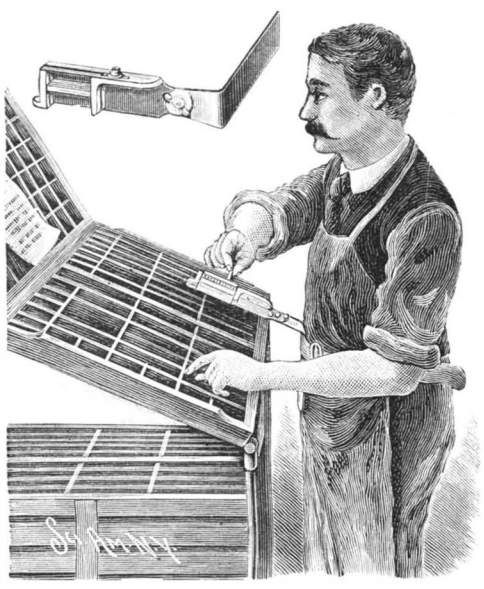
AN IMPROVED PRINTER'S COMPOSING STICK.

The illustration shows a compositor's stick designed to be conveniently supported from the body, instead of being held in one hand, so that both hands may be utilized in setting up the type, the stick being also provided with a yieldingly mounted plate to hold the type in place while the line is being formed. The improvement has been patented by Mr. Arthur A. Hill, of No. 327 West Twenty-third Street,



HILL'S PRINTER'S COMPOSING STICK.

New York City. The bottom plate of the stick, where it is usually held in the hand, is connected by a set screw with the outer end of a bent rod, whose inner vertical portion is held in a socket formed in a belt strapped around the body of the compositor, the arm being adjustably held at the desired height by a set screw. In the L-shaped adjustable piece, by means of which the length of the line is regulated, and also in the end piece at the outer end of the line, are grooves about half-type high, extending in the direction of the length of the column. In these grooves slide lugs on the ends of a yieldingly mounted plate, fitting the measure to which the stick is set, as would a compositor's rule, but the plate is straight only on its lower portion, its upper part being bent or rolled outward to form a mouth-like opening for conveniently inserting the type between the plate and an ordinary printer's rule. In case of leaded matter, the spacing lead will answer the purpose of the printer's rule. This enables the compositor to place the type in position without following the motion of the hand with the eye. The ends of a spring band, extending over a part of the back of the stick, engage the lugs on the ends of the sliding plate, and hold it yieldingly against the type as the line is being formed, so that it is not necessary to hold each piece in place by the thumb until the next one is inserted, and both hands may be used to pick up the type from the case and place them in position in the stick.

THE DESROZIERS CONTINUOUS CURRENT DYNAMO.

We present an illustration of a type of dynamo which possesses some features of marked originality, and which, *Engineering* says, has been making rapid strides in the estimation of electrical engineers and the public on the Continent.

The inventor of this machine is M. Edouard Desroziers, ingenieur des mines et expert pres le conseil de la Prefecture de la Seine, well known in connection with electric lighting and traction enterprise in France, where the dynamo we illustrate has for some years past been superseding other types in the leading central stations in that country.

A short description will suffice to indicate the striking features of this dynamo machine. Our illustration is of a 100 kilowatt machine, which, it will be seen, has the general appearance of a multipolar dynamo. The special feature is to be found in the armature, which is built up without an iron core, and which, owing to its large diameter, is well adapted to direct driving, now becoming more and more recognized as a desideratum for central station and electric traction purposes among leading electrical engineers in this country. In Fig. 2 the method of winding is shown. The core is composed of a round disk of papier mache, which is divided into a number of segments, 32 in this instance. Starting from a point, R, the armature conductor is curved along the circumference until it reaches a segment at C, where it is passed through the perforated papier mache disk, and carried radially down the other side to the hub, where, at *d*, it is again threaded through the disk. It is then carried along the hub until a segment at *h* is reached, when it is brought radially up to the circumference again, and so on until the whole armature is wound. The threading of the wire through the perforated and recessed disk holds the conductor rigidly in place, thus disposing of a fruitful source of trouble in dynamo machines as ordinarily constructed. The papier mache is cut away, as in Fig. 3, finally, thus resulting in thorough ventilation for the whole structure, and so enabling a higher current density than usual to be employed. Stability is given to the whole by "spiders" of German silver, keyed on to the shaft, and preventing the displacement of the disk and its conductors. More than forty-five of these machines have been supplied to the French navy, and as many more are in course of construction, while the Messageries Maritimes and other steamship lines have adopted them largely. But it is for the purpose of central station and electric traction that these dynamos have made their special mark. Four dynamos, with an output of 640 horse power, have been installed at the central station in the Rue de Bondy, Paris, and the same number of equal power at the central station of the Nord. Fourteen dynamos aggregating 2,200 horse power have been supplied to the Compagnie Parisienne de l'Air Comprimé for the Popp central stations in the same way. Among many private installations those of Baron Alphonse Rothschild and Baron Gustav Rothschild, at the Chateau de Ferrieres and the Chateau de la Versine, may be enumerated. Many others have been supplied to the governments and private firms in Russia and Austria. In all, dynamos aggregating about 12,000 horse power have been manufactured by the Maison Breguet, who are the makers of the dynamo in France, and it will thus be seen that these machines are adapted for all purposes for which continuous current dynamos may be required.

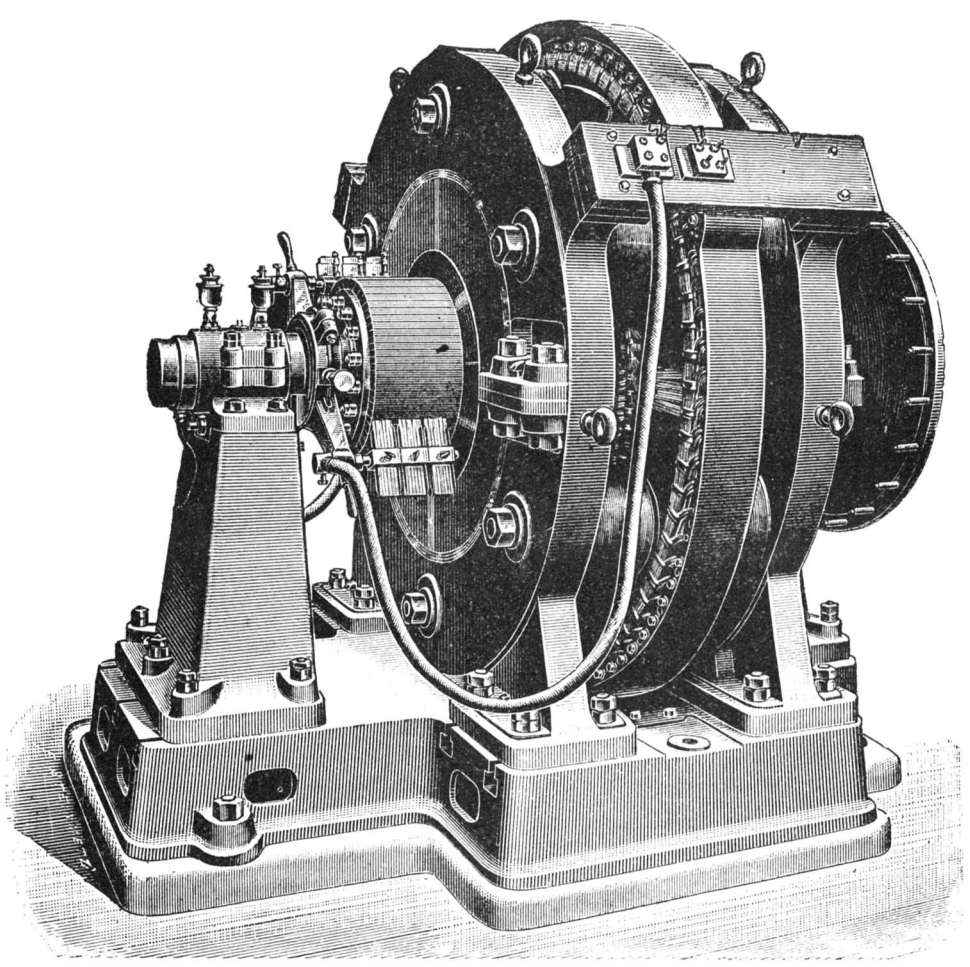


Fig. 1.

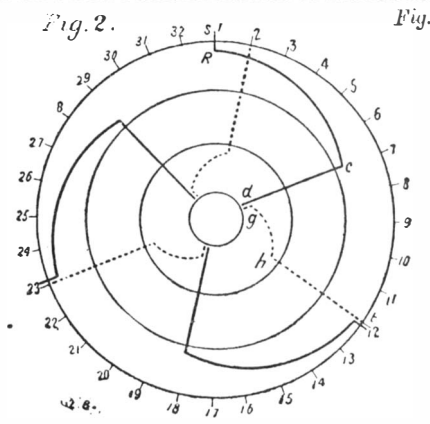


Fig. 2.

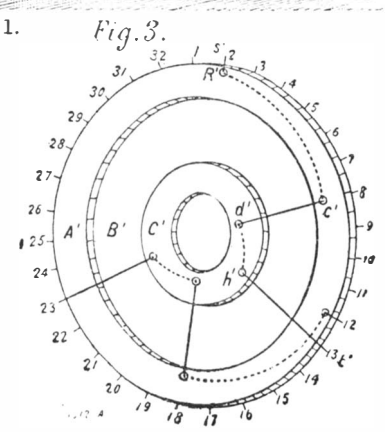
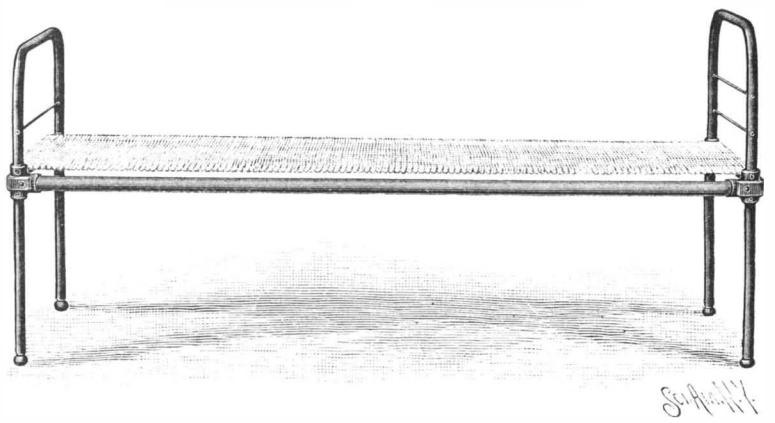


Fig. 3.

THE DESROZIERS DYNAMO.

A STRONG AND CHEAP BEDSTEAD.

An iron bedstead especially adapted for use in prisons, insane asylums, etc., is shown in the picture, and has been patented by Mr. John J. Dugan of Salem, Oregon. As will be seen, it is made of but few



DUGAN'S INDESTRUCTIBLE BEDSTEAD.

parts, strongly put together, and there are no legs or other pieces which can be wrenched from the bed and used as weapons. The head and foot pieces each consist of a single length of bent iron pipe, the opposite posts thus formed being connected by cross braces which are simply iron rods extending through the posts. On each post is an ordinary T-coupling, held in place by a bolt, the couplings supporting the side bars, which are simply pipes screwed into the nipples of the couplings and fastened by bolts. At the head and foot are transverse angle irons, having perforations to which the mattress may be fastened, each iron being recessed at the ends to fit against the couplings, and having end straps bent around and fastened to the nipples by bolts, whereby all the parts are firmly bound together. The woven wire mattress is stretched from one end angle iron to the other, and its ends are doubled under straps or bars fastened to the tops of the irons by bolts, thus firmly clamping the mattress in place.

Language in Determining Human Races.

French anthropologists agree that a few anatomical characters are not enough to determine a type of race, and that it is necessary to investigate all or as many as possible of such characters. Anthropology does not interfere with ethnology, because each has its distinctive field of inquiry. Anthropology does not say that physical characters are superior or inferior to linguistic characters; it says that the two sciences are of a different order and for a different purpose. The first relates to the physical element constituting peoples; the second to the classification of these peoples. Language grows, loses, borrows, changes, transforms, and all this independent of anthropological characters such as beliefs, customs, industries. Physical characters are hereditary and inherent in the blood, but linguistic characters are not. If a Red Indian is born among strangers and without the society of his parents or race, he will speak not his own language but that of those who rear him; but he will retain all of the physical characters of his race, notwithstanding. Different and opposing races may speak the same language, and on the other hand the same race may speak different languages.

IF not absolutely the oldest, the Stora Kopparberget in Sweden is the oldest copper mine of which we have any official figures. It has been worked continuously for nearly 800 years, and a table is given which shows the production for each year since 1633. This is probably the only mine in the world for which figures of production for 260 years can be shown.

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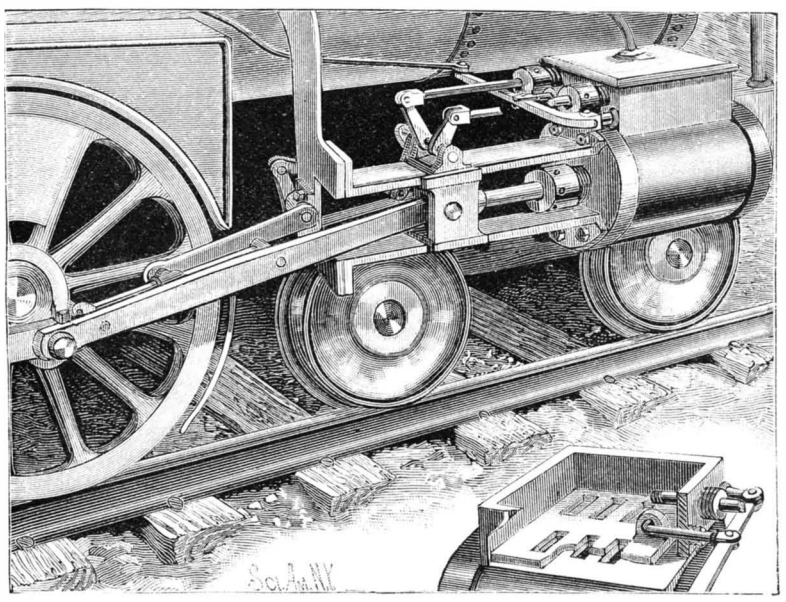
A REVERSING GEAR FOR ENGINES.

To facilitate the reversing of the engine without the use of the link motion is the object of the improvement represented in the illustration, which forms the subject of a patent issued to Messrs. Thomas F. Whittington and William A. Fishering, of Xenia, Ohio. The cylinder has the usual inlet ports, and the exhaust port adapted to register with sets of ports formed in a movable valve seat held adjustably in the steam chest on the cylinder, as shown in the small view. A stem connected to the movable valve seat extends through one end of the steam chest, and is pivotally connected with a lever in reach of the engineer, when the improvement is applied to an ordinary engine, but in a locomotive this lever is connected to a rod which extends to within easy reach in the cab. On the movable valve seat, over the respective ports, are slide valves whose stems extend through stuffing boxes in one end of the steam chest, the outer ends of the stems being connected with arms, one of which is secured on a transverse shaft while the other is secured on a sleeve loosely mounted on the shaft. On the shaft and on the sleeve are arms connected by links with the ends of an arm secured at its middle on a rocking shaft, an arm secured to which is connected with a sleeve sliding on a rod on the pitman, the swinging motion of which imparts a longitudinal sliding motion to the valve stems in opposite directions. With the movable valve seat in one position one of the slide valves is rendered inactive, and with it in another position the other slide valve is inactive, and by giving but a half movement to the movable valve seat, the two sets of ports can be disconnected from the cylinder ports, enabling the engineer to shut off steam in case of accident to the throttle or other parts of the locomotive. As the movable seat can readily be changed whenever it is desired to reverse the engine, the usual link motion employed for reversing is entirely dispensed with.



WHITTINGTON & FISHERING'S REVERSING GEAR FOR ENGINES.

A HANDSOME TEAM OF CATTLE.

To the Editor of the Scientific American:

After having your paper in our family since 1859 I take the liberty to send you a picture of three white cattle, the Jumbo team, weight 6,000 pounds, half brothers, not three days difference in age. All white as snow from three cows that were not alike. The breeding being remarkable. Names Jupiter, Saturn, and Uranus as they stand. They are used as a team for all heavy farm work, are quiet and thoroughly broken, making a powerful team. They were bred by me, and are six years old.

JAS. GALLOWAY.

Pontiac, Michigan, 1893.

Growth of the Great West.

The Mississippi River has 600 affluents whose courses are marked upon the map, and a drainage area of 1,257,545 square miles. The traveler embarking upon a steamboat can sail from Pittsburg, 4,300 miles, to Fort Benton, Mont., and from Minneapolis, 2,200 miles, to Port Eads, on the Gulf of Mexico. Should he choose to extend his voyage to the head of navigation upon its 45 navigable tributaries, his outward journey would exceed 16,000 miles, through 23 States and Territories of the Union, says the *Industrial World.*

This stupendous water system is equivalent to a land-locked harbor, an estuary or an arm of the sea, penetrating into the North American continent farther than from New York to Liverpool, with a coast line of 32,000 miles, having hundreds of populous towns and cities, and innumerable ports and havens, from which the agricultural and manufactured products of one-third of the arable surface of the United States can be shipped to all parts of the globe. The territory which it drains is considerably larger than central Europe. Lying wholly in the temperate zone, equally removed from the languors of the tropics and the rigors of the pole, its climate favorable to health and longevity, its calcareous soil adapted to every variety of agriculture, it is the region where the elements of prosperity are most abundant and stable, and the conditions of happiness most permanent and secure among the habitaticns of men.

One hundred years ago, the pioneers from New England, the advance guard of the great column of Anglo-Saxon migration that has during the interval marched to the Pacific, abolishing the frontier and conquering the desert, descended the western slopes of the Alleghenies into the valley of the Ohio and disappeared in its solitudes. Chicago, Cincinnati, and St. Louis were outposts of civilization, exposed to the brand and the tomahawk. A few log huts, trading stations and mission houses were scattered along the crumbling banks of the rivers and in the profound depths of the forests. There were neither highways nor public conveyances, commerce, agriculture nor manufactures, no schools, churches, nor society, nothing but nature and its vicissitudes, the savage and his prey. From that unsurveyed wilderness, in less than a century, 21 States have been admitted into the Union, having an area of 800,000,000 acres, a population of more than 35,000,000, and wealth beyond measurement or computation. Sparsely inhabited, with rude and unscientific methods, its resources hardly touched, the States of the Mississippi Valley last year produced more than three-quarters of the sugar, coal, corn, iron, oats, wheat, cotton, tobacco, lead, hay, lumber, wool, pork, beef, horses, and mules of the entire country, together with a large fraction of its gold and silver. Their internal commerce is already greater than all the foreign commerce of the combined nations of the earth.

China supports 400,000,000 people upon an area smaller and less fertile. The civilization of Egypt, whose monuments have for forty centuries excited the awe and admiration of mankind, was nourished by the cultivation of less than 10,000 square miles, in the narrow valley and delta of the Nile. The delta of the Rhine, and the adjacent lands reclaimed from the Zuyder Zee, less than 15,000 square miles, have long sustained the United Kingdom of the Netherlands, and given to a dense population wealth, comfort, and contentment. The delta of the Mississippi, below its junction of the Ohio, richer than the Nile or Rhine, exceeds the combined area of Holland and Egypt, and is destined, under the stimulus of free labor and the incentives of self-government, to build a fabric of society more opulent and enduring. Add to this the inexhaustible alluvium of the streams above, and the fertile prairies from which they descend, and the arithmetic of the past has no logarithms with which to compute the problems of the economic and commercial future of the West. It will be predominant in the development, not of this country alone, but of the hemisphere, and will give direction to the destinies of the human race.

When the first furrow was broken on the prairies of Illinois, there was not an iron plowshare in the world. Men are yet living who might have seen the first steamboat on Western waters, on her trial trip from Pittsburg, in 1811, and who were in active life when the first passenger rode in a railway train, and the first telegraphic dispatch was sent. The early settlers of Missouri had to depend on flint and tinder for fire. Most of the inventions in machinery, nearly all the appliances for comfort and convenience, were unknown to the pioneers of the West. Their victories were won with few of the methods and devices now regarded as indispensable in even the humblest walks of life. When its agricultural, mining, and manufacturing resources are fully developed by steam and electricity, the Mississippi Valley will support and enrich, without crowding, 500,000,000 people, and be not only the granary but the workshop of the planet.

The Railroad Y. M. C. A.

The railroad department of the Young Men's Christian Association now has a membership of 20,000 railroad employes, and is organized at over one hundred division points. The railroads appreciate the value of the Y. M. C. A. to the men and contribute over $100,000 annually to its support. The officials of the railroads desire to provide influences to counteract the saloon and other evils which tend to debase and demoralize the men, and thus render them unfit for service in the responsible positions in which they are placed. The privileges of the association include reading rooms, libraries, bath rooms, parlors, gymnastics, bowling alleys, lunch rooms, educational classes, entertainments, religious services, and social receptions. Some of the privileges are free to all employes of express, telegraph, railway, and palace car companies and mail clerks, but certain privileges, such as baths, etc., are exclusively for members of the association. The Pennsylvania Railroad Company has contributed $10,000 toward a railroad Y. M. C. A. building in Philadelphia, besides donating a lot worth $22,000. An interesting pamphlet is published by the International Committee of Young Men's Christian Associations at 40 East 23d Street, New York City. It is entitled "A Railroad Problem and its Solution." Mailed to those interested on receipt of postage.

Trial of the Bancroft.

The third and final trial of the United States steamer Bancroft took place in Long Island Sound July 13. A speed of 14·4 knots was attained, although the contract only called for 12 knots. The battery tests were very successful, as was also that of the Williamson steam steering apparatus. A complete circle was made in four minutes thirty-three seconds, with both engines running at full speed; and in seven minutes forty-two seconds, with starboard engine going ahead and port engine backing hard. The compasses showed, upon testing, a marked deviation, owing to the fire of the batteries. This phenomenon is not new, but rarely has the change been so clearly shown to be due to battery fire as in this case.

A PRIZE TEAM OF CATTLE.

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WORLD'S FAIR NOTES.

(*Continued from page 83.*)

plies, it is composed of a large glass jar fitted with a lid which screws down tight. Two glass tubes extend through the lid, and one reaches the bottom of the jar. Water is run through the longer of the tubes into the jar, which is about half full of the tiny eggs of the fish, and maintains them in continual motion. Unless the eggs are thus kept moving, they would very soon first unite and then decompose. The spawn is thus agitated until a pair of eyes show through the thin membrane that envelops the egg. Then the tail begins to develop, and as it grows it swings round until the egg breaks. Eventually the fry is carried by the overflow tube to a still larger glass jar called the nursery. Food in a comminuted state is there supplied to the fry, and as soon as the young is large enough it is introduced to a large tank and fed with bigger pieces of food. Finally the sufficiently matured fishes are shipped off to wherever there is need of a finny population in lake or river. It takes four days to hatch a shad, but whitefish require from forty to a hundred and twenty days under the same conditions.

A Bible which came from England in the Mayflower and was in use on board that vessel in 1620 is to be seen at the World's Fair. It is the property of Mr. and Mrs. James L. Gates, of Milwaukee, Wisconsin. Mrs. Gates came to possess the prized volume through her father, Mr. John G. Meade, of Northwood, N. H. It has been owned successively by the Winthrops, Moultons, Howlands,Hiltons and Meades, these being the ancestors of Mrs. Gates. This Bible was published in London in 1611. There is no doubt of its history; considering that it is 282 years old, it is remarkably well preserved. It is quite complete from Exodus XV. to the First Epistle of John. The type is large and clear, and the press work first class. The book typographically must have been high up in its day and generation. It is a pure King James, and mention has been made of it in the encyclopedias as historic. Both the boards of the cover have been gone long ago, but a piece of the back is still attached. Though the leaves are faded they are still strong and clean. Frequent notes are entered on the borders and bottom of the pages. The old-fashioned "s" of the form of an "f" is used.

Among the objects of interest that were intended to be exhibited at the World's Fair was a checker board, a remarkable result of taste, skill, and patience. Charles Manson is the name of its maker. He was born in Sweden, and there he acquired the art of wood carving, for which so many of his countrymen seem to have a natural aptitude. He now claims Chicago as his residence. The board is 20 inches square and is mounted on cork legs 3 feet high. This table is composed of no less than 28,070 pieces of wood, representing almost every known kind of timber, from the cedar of Lebanon to the pine of Georgia. Some of the pieces are as thin as paper, and every one of them was cut by hand. It took three years to finish the work. On the top the variously colored woods are arranged so as to make very effective mosaic groups. The cost of this table has been estimated at $1,000. Occasionally, in modern times, prolonged application of artistic talent has been put forth by mechanics, and where the result is worth the pains, it has a moral effect of considerable value; but to see what man can accomplish in minute objects requiring a great many years for their completion, one has to go back to ancient Babylon. The products of the seal and stone cutters of that famous seat of civilization are at this day a marvel. What sustained them in the long task, and enabled them to execute so exquisitely in the very minutest details, was, as an antique motto has it, "loyalty to the sovereign and fidelity to the gods."

In the Old Vienna department of the Midway Plaisance there is on view a most interesting collection of mummy portraits. When the body of an ancient Egyptian was embalmed, it was the custom of the relatives to place his portrait outside the mummy case. The portrait was generally painted on a thin wooden panel, and it was so laid over the face of the deceased, and so wrapped round the edges by the shroud, as to produce the effect of a living person looking out from the drapery at the mourning friends when they paid a visit to the place of sepulcher. Recently great numbers of such portraits have been discovered in an excellent state of preservation. The execution is in many instances excellent, and the color still remains surprisingly fresh. These portraits have been found of much scientific value from an ethnological point of view.

The threatened war in Siam has fixed all eyes upon that little country, and the exhibits of Siam at the Fair are coming in for a full share of the awakened interest. The display of the kingdom of the white elephant though small is creditable; fine wood, ivory, and metal work fills up the small pavilion, or rather pagoda, in the Manufactures building. Some idea of the richness of the metal work may be obtained when it is stated that a single cuspidor exhibited is valued at $500. In front of the pagoda are enormous elephant tusks valued at $2,000 apiece. The display in the Agricultural building is very fine, some of the Siamese plows being inlaid with mother-of-pearl. The Siamese excel in fruit preserving, many of them being carved into the form of flowers. In the Transportation building may be seen bullock carriages, the joss chairs used by priests in carrying idols, green chairs for officials, and various kinds of boats.

Many of the exhibits at the fair have a card fastened to them, asking visitors in English, French, German, Italian, Spanish, Turkish, and Arabic not to touch the articles exhibited. It is very noticeable that most of the handling of articles is done either by the Hoosier or the Connecticut Yankee, and the exhibitors fear the deadly umbrella which is frequently used to see whether a porcelain jar is hollow or not. A correspondent saw four pieces of fine Austrian glassware swept off the exhibition table in the Manufactures building, a few weeks ago, by a woman with an umbrella with which she pointed to the exhibits.

The sign "Sun Spots Now on View" attracts crowds to the Naval Observatory. The government does everything at the Fair in the most liberal manner and the observatory is open to visitors from 1 to 5, and on pleasant evenings from 8 to 10 o'clock the lieutenant in charge entertains visitors by views of the stars. The sun spots are finely shown by the five inch equatorial.

The other evening a sky-rocket crashed through the roof of the Manufactures building and set fire to one of the curtains near the roof; three firemen climbed out on one of the cross beams and tore down the curtain, which was extinguished when it reached the floor. It is the opinion of Exposition officials that, had the roof of the Manufactures building been crowded with visitors, as doubtless would have been the case but for the recent action of the administration in regard to prohibiting visitors from ascending to the roof, a panic would have ensued that must have resulted disastrously. Hereafter all fireworks will be set off from floats moored 1,000 feet out in the lake.

The National Commission has given notice for all exhibitors and others who contemplate bringing suits against the United States government for losses and damages sustained by them at the World's Fair, to file an itemized account of such claims. It is understood that already suits amounting to $400,000 have been prepared. The suits are mainly on account of damage to exhibits. It is a significant fact that the government had to pay $300,000 after the New Orleans Exhibition.

Alexis Columbus, of Buffalo, aged one hundred and four years, has arrived in Chicago. He is said to be a lineal descendant of Columbus, who was the great-great-great-great grandson of Christopher Columbus, whom he resembles in a remarkable degree.

Sweden began a three days' celebration on July 20, when a mighty column of people from the land of the Midnight Sun entered Jackson Park with music playing and yellow and blue banners waving everywhere. Fifteen thousand people marched in the parade, each with a knot of blue and yellow somewhere about the person. The singing societies rendered appropriate music. The Swedish building was thronged all day, and the exhibit of this rich little country was much admired.

The huge search light on the Manufactures building was made by Schuckert & Co., Nuremberg, Germany. The lamp requires 150 amperes and 50 volts. The mirror is 5 feet in diameter, and the thickness is nearly an inch. It is heavily silvered on the back. The lamp is operated by small electric motors. The surface intensity of this mirror is 194,000,000 candle power, and the light is so brilliant that a newspaper may be read by its light eight miles distant.

POSITION OF THE PLANETS IN AUGUST.

JUPITER

is morning star. The stately planet is in quadrature on the 22d at 10 h. 53 m. P. M., when he is 90° west of the sun. He is then symmetrically placed half way between conjunction and opposition, rising about midnight, and making his meridian passage about sunrise. He will appear before midnight, after quadrature, and the time will soon come when it will no longer be necessary to rise in the small hours of the night to behold this radiant orb. Everything about this planet is interesting, and is becoming more so as investigation is more closely directed to his cloud surface and the movement of his satellites.

The great red spot of 1878 is as much of an enigma as it was when first discovered. The brilliant astronomical event of 1892 was the discovery of Jupiter's fifth satellite. Latest of all, Mr. Pickering from his eyrie at Arequipa reports some anomalous proceedings of the Jovian satellites, especially the first satellite. It presented a variety of form or shape, being elliptical, round, almost round, perfectly round, with all the intermediate phases. The third satellite on emerging from behind the disk of the planet was flattened in a direction parallel to the planet's border. The observer suggests that the Jovian atmosphere is the cause of the flattening.

Jupiter in quadrature is in fine position for observing his satellites. The following are some of the most interesting configurations. They are taken from the Nautical Almanac, are for an inverting telescope, are given in Washington mean time, and 1 o'clock in the morning is the hour to look for them.

On the 3d, I, II, III, IV, are all on the right or eastern side of the planet.

On the 7th, IV is making a transit, I and III are on the left, and II is on the right.

On the 8th, II is making a transit, III and IV are on the left and I is on the right.

On the 12th, I is making a transit, II and IV are on the left and III is on the right.

On the 17th, II, I, III, IV, are all on the right.

On the 20th, I is occulted, II and III are on the left and IV is on the right.

On the 23d, III is occulted, I and II are on the left and IV is on the right.

On the 27th, I, III, II, IV are all on the left.

The moon, two days after the last quarter, is in conjunction with Jupiter on the 6th at 3 h. 13 m. A. M., being 4° 10′ north. The conjunction is visible, occurring an hour and a half before sunrise.

The right ascension of Jupiter on the 1st is 3 h. 43 m., his declination is 18° 43′ north, his diameter is 36″.0, and he is in the constellation Taurus.

Jupiter rises on the 1st at 11 h. 47 m. P. M. On the 31st he rises at 9 h. 59 m. P. M.

VENUS

is evening star. Her movement in this part of her course is very slow, She remains at about the same distance from the sun during August as she did during July, setting about an hour and five minutes after the sun on the 1st and an hour and twelve minutes on the 31st. She is, however, coming toward us, for her size and brightness are increasing. Her diameter, which, at superior conjunction, was 9″.8 is at the end of the month 12″.8, her light number, which at superior conjunction was 46.6, is at the end of the month 63.7, and instead of being a full round orb represented by unity or 1, her enlightened surface is indicated by 0.843 at the end of the month, and she is decidedly gibbous when seen in the telescope. Figures are, however, not needed except to strengthen the impression. The observer who watches the sunset will in a short time behold the star where sweetness and serenity are enthroned, and will readily recognize the approach of the planet to the earth from her greater brilliancy.

The moon, when a two days' old crescent, is in conjunction with Venus on the 13th, at 6 h. 0 m. P. M., being 1° 41′ north. Moon and planet will be near each other when it is dark enough to see them.

The right ascension of Venus on the 1st is 10 h. 27 m., her declination is 11° 21′ north, her diameter is 11″.4, and she is in the constellation Leo.

Venus sets on the 1st at 8 h. 20 m. P. M. On the 31st she sets at 7 h. 43 m. P. M.

MERCURY

is the evening star until the 8th, and then morning star. He is in inferior conjunction with the sun on the 8th, at 5 h. 3 m. A. M., when he appears on the sun's western side to commence his short career as morning star. He reaches his greatest western elongation on the 25th at 9 h. P. M., when he is 18° 16′ west of the sun, and is visible to the naked eye as morning star.

The moon, on the day of her change, is in conjunction with Mercury on the 11th at 2 h. 5 m. A. M., being 9° 32′ north.

The right ascension of Mercury on the 1st is 9 h. 27 m., his declination is 10° 4′ north, his diameter is 11″.0, and he is in the constellation Leo.

Mercury sets on the 1st at 7 h. 16 m. P. M. On the 31st he rises at 3 h. 59 m. A. M.

SATURN

is evening star. He is in conjunction with Gamma Virginis on the 8th, being 34′ south. After that time he recedes from the star, and will return to its vicinity only after making a thirty years' trip around the zodiac. Saturn and the double star have for several months been objects of great interest to naked eye observers, while the telescope has brought them out in almost unrivaled splendor. The planet encircled by its rings and moons, and the noted double star, sometimes seen in the same field, have had many enthusiastic admirers. European astronomical journals abound in appreciative descriptions of the unique celestial picture. The exhibition closes during the present month.

The moon, when four days old, is in conjunction with Saturn, on the 15th, at 9 h. 59 m. A. M., being 1° 26′ south. The conjunction is invisible, occurring in the daytime.

The right ascension of Saturn on the 1st is 12 h. 34 m., his declination is 1° 11′ south, his diameter is 15″.6, and he is in the constellation Virgo.

Saturn sets on the 1st at 9 h. 44 m. P. M. On the 31st he sets at 7 h. 52 m. P. M.

MARS

is evening star. He is in aphelion on the 16th at 11 h. P. M., and at his greatest distance from the sun, 18,-

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000,000 miles further from him than when in perihelion. As he is less than three weeks from his conjunction with the sun, he is also at nearly his greatest distance from the earth. At his opposition last August, which was near his perihelion, he was 35,000,000 miles from the earth, and his diameter was 26".6. At his aphelion on the 16th he is nearly 247,000,000 miles from the earth, and his diameter is 3".8. The apparent brilliancy of the planet must, therefore, vary greatly from the immense changes of distance.

The moon, the day after her change, is in conjunction with Mars on the 12th at 3 h. 31 m. A. M., being 3° 14′ north.

The right ascension of Mars on the 1st is 9 h. 34 m.; his declination is 15° 43′, his diameter is 3".8, and he is in the constellation Cancer.

Mars sets on the 1st at 7 h. 44 m. P. M. On the 31st he sets at 6 h. 34 m. P. M.

URANUS

is evening star. He is moving eastward or in direct motion, and must be looked for, with the aid of a telescope, between Alpha Libræ and Lambda Virginis.

The moon, two days before the first quarter, is in conjunction with Uranus on the 17th at 3 h. 11 m. P. M., being 1° 59′ south.

The right ascension of Uranus on the 1st is 14 h. 18 m., his declination is 13° 23′ south, his diameter is 3".7, and he is in the constellation Virgo.

Uranus sets on the 1st at 10 h. 43 m. P. M. On the 31st he sets at 8 h. 48 m. P. M.

NEPTUNE

is morning star. He has advanced in his course so far west of the sun, rising at the end of the month about 11 o'clock in the evening, that he is visible in large telescopes. He may be found about 4° north of Aldebaran.

The moon, three days after the last quarter, is in conjunction with Neptune on the 7th at 3 h. 31 m. A. M., being 5° 31′ north.

The right ascension of Neptune on the 1st is 4 h. 47 m., his declination is 20° 53′ north, his diameter is 2".5, and he is in the constellation Taurus.

Neptune rises on the 1st at 0 h. 45 m. A. M. On the 31st he rises at 10 h. 49 m. P. M.

Venus, Mars, Saturn and Uranus are evening stars at the close of the month. Mercury, Jupiter and Neptune are morning stars.

Nansen's Polar Expedition.

Dr. Nansen sailed from Christiania, Sweden, for the North Pole on June 26. The vessel which carries the expedition is the Fram, which was built, under the direction of Dr. Nansen, with a view to resisting the thrust of the ice-pack. This vessel is fully described in SUPPLEMENT 882. Provisions sufficient for five years are carried, though it is not expected that the trip will take as long as that. The vessel will follow as near as possible the path of the ill-fated Jeannette. It is believed that articles, which were afterward found in Greenland and which were identified as belonging to the Jeannette expedition were carried directly through the polar sea, passing the pole *en route*. Now Dr. Nansen believes that if he rams the Fram into the ice-pack, he will be carried in precisely the same manner as the articles from the Jeannette, and that finally he will land on the east coast of Greenland. This is an excellent theory, and there is considerable chance of its being the true one; but it remains to be seen if the Fram is strong enough to stand the enormous pressure which ground the Jeannette to pieces. Dr. Nansen estimates that three years will probably be necessary to allow for the drifting in the ice-pack. He fully expects to return, and we hope the brave explorer may do so.

Chinese Use of Towels.

It appears from the latest consular report from Swatow, in Southern China, that among cotton goods the import of towels alone has shown any improvement. But, the consul explains, this does not imply any increased attention to personal cleanliness on the part of the inhabitants of the district, for the towels are used for clothing. The breadth of the ordinary towel being that from shoulder to shoulder, two sewn together will make a coat. Sleeves are dispensed with, and except for the armholes there is none of that waste of material which is especially repugnant to the Chinaman, and which the size of his native piece goods and the fashion of his clothes conspire to avoid.

ONE of the most troublesome pests that inflict housekeepers are the red ants. And when they once get into a house, they are very difficult to dislodge. The writer had a trying experience with them for a long time. Every effort to get rid of them was without avail. In his dire extremity he applied to Sallade & Co., 53 West 24th Street, for relief. The result was the Sallach Company, with their insect exterminator, accomplished their work most satisfactorily and the house is free of ants.

THE FRENCH EXHIBIT OF LOCOMOTIVES.—THE BETHLEHEM IRON COMPANY'S EXHIBIT AT THE WORLD'S FAIR.

The Transportation building at the World's Columbian Exposition is justly popular, and is usually thronged with interested visitors. We have already illustrated the magnificent "golden gateway" of this great building, and we now present a view of the interior. The most striking object, and that which at once arrests the attention of every spectator, is the great model of the Bethlehem Iron Company's steam hammer. It occupies the center of the transept, and the open space below the hammer proper forms an archway of grand proportions. It is very appropriate that this modern "Colossus of Rhodes" should rise amid the models and sections of great ocean steamers and battle ships, which depend to so large an extent upon the products of the forge. The height of the hammer from floor to cylinder head is ninety-one feet. The anvil block is removed and exhibited at one side. The Bethlehem hammer, of which this is a model, is a 125 ton hammer, and one of the largest in the world. The plates of the seventeen-inch armor which recently stood very satisfactory tests at Indian Head, on the Potomac, were forged by means of this machine. The model is built of wood and staff, so cunningly fashioned that in outward appearance it resembles a mass of metal.

The exhibits of the Bethlehem Company near by are divided into three sections. In the first are the products of the hydraulic forging presses, two huge hollow steel forgings which form the barrel and jacket of a 13 inch navy gun. A smooth-forged trunnion hoop used for securing one of the new 12 inch, 50 ton army guns to the carriage is exhibited, also a 12 inch breech-loading rifle, made at the Washington Gun Factory, from the Bethlehem Company's fluid-pressed hydraulic-forged steel. This rifle, which has a muzzle velocity of 2,000 feet a second, weighs 45 tons and is 37 feet long. With a charge of 450 pounds of powder, an 850 pound projectile will perforate over 22 inches of iron. This little plaything has been christened "Alice."

In the second section of the exhibit is a model of a 113 ton steel ingot from which the colossal armor plates are forged. An extraordinary example of forging is a seven-foot ventilator for the monitor Puritan; this was forged in one piece without welds, the material nickel-steel. A seventeen-inch nickel-steel armor plate on exhibition is curved, showing the enormous power exerted by the great bending presses. A thirteen-inch plate of the battle ship Indiana is shown, as well as a case-hardened nickel-steel plate 10½ inches thick, which was used as a target for five 8 inch Holtzer shells; the plate was not seriously injured. A remarkable exhibit in this section is an ingot similar to the one from which the Ferris wheel shaft was forged. This ingot, which is 15 feet long and 54 inches in diameter, is made of fluid compressed steel and weighs over 48 tons. The shaft of the Ferris wheel was one of the largest forgings ever made, the ingot weighing 65 tons.

In section three is a hollow shaft, hydraulic forged, 67 feet long, 20 inches in diameter, and weighs 30 tons. This shaft is identical with the one furnished the Old Colony steamer Puritan. A counterbalanced crank for the City of Sydney, a Pacific Mail Steamship Company's steamer, is a good example of built up work. In addition to a solid crank for the cruiser Minneapolis a quantity of air cushion cylinders, billets, ingots, etc,, are exhibited. On the whole, the exhibit of the Bethlehem Company does the highest credit to that enterprising corporation. The various products shown are exquisitely finished.

At the left, and beyond the hammer, will be seen the black and white stack of the International Navigation Company's steamer, or, rather, section of a steamer. This section might be called on the theater stage "practicable," for visitors are allowed to wander at will through the saloon, smoking room, and cabin.

At the right of our engraving will be seen the artistic pavilion of the Adams & Westlake Company of Chicago, manufacturers of railway car supplies. The pavilion is built of wood and staff and is highly artistic. The Adams & Westlake Company are the largest manufacturers in the world of brass, bronze, and white metal car trimmings. Railroad lamps are a specialty with this firm, and include car lamps, headlights, tail lamps, signal lamps, and lanterns. Car window curtains, baggage racks, coat hooks, and the thousand and one articles of railway hardware are all supplied by this firm.

At the extreme right will be noticed a part of the model of the city of Pullman, which forms a very interesting exhibit. This industrial city was founded by George M. Pullman, and, though established only thirteen years ago, the population already numbers more than 8,000. Pullman is in the city of Chicago, though fourteen miles from the City Hall, and is located on the Illinois Central Railway. Here are centered the great interests of the Pullman Palace Car Company, the Allen Paper Car Wheel Company, the brick works, etc. It was pre-eminently the design of the founder to build a city in which, as far as possible, all that would promote the health, comfort, and convenience of a large working population would be conserved, and many of the evils to which they are ordinarily exposed made impossible, while at the same time conducting the enterprise on sound business principles, looking for a moderate and sure return on the capital invested. Pullman is in many ways a model town; the wide, clean streets, the excellent water and sewage pumping systems render Pullman a healthy and pleasant place to live in. The town is well worthy of a visit, and, with proper introductions presented at the Chicago office, there is no difficulty in obtaining permission to visit the interesting shops of the company. The great Centennial Corliss engine runs the works. The model exhibited in the Transportation building gives an excellent idea of the way the town is laid out and of the principal buildings.

One of the most noticeable and unique exhibits in the Transportation building stands in the space allotted to French exhibits, just south of the center of the building and east of the main aisle, near the great hammer. This exhibit consists of a pyramid of wrought iron locomotive and car wheels of all descriptions, partly shown in our engraving. The wheels exhibited are of various sizes and designs, as can be seen from the illustration, and are all made in the Couzons works of Arbel, at Rive de Gier, France.

The *Railway Review* says the works, as they now exist, are specially fitted for making wrought iron wheels, forged under the steam hammer, and can make wheels of every size from those of 9¾ inches in diameter, for use under mine trucks, up to high speed locomotive wheels of 87 inches in diameter. Between 300 and 400 men are employed, gas heating furnaces are used, and also every other new improvement which the business demands. By these improvements the company are enabled to guarantee a service for their wheels of 300,000 miles.

The process of manufacturing the car wheels in the Couzons works is practically as follows: The rim is first cut to length, bent to the proper radius and the ends welded, the welding being partially accomplished by means of a screw clamp while the rim is in the fire. The rim is then divided into as many equal parts as the wheel is to have spokes, and by means of a special shaping machine grooves are cut, which receive them. The spokes are rolled to an elliptical shape, cut to the proper length and upset on the ends to form the proper foot for welding, this work being done vertically in a special die prepared for the purpose.

The hub is made in halves, and each half is formed of a rectangular iron bar, rolled around a conical mandrel under the steam hammer. The pieces are then reheated, put under the steam hammer, and recesses stamped therein for receiving the spokes, after which the wheel is made up. In making up the wheels they are laid together as the wheel has considerable dish. This is done in order to insure a perfect weld in stamping, as the compression on the spokes forces the pieces of metal together.

The wheels, fitted as described, are transferred to a heated furnace, and the construction of these furnaces is one of the special features which Messrs. Arbel claim has much to do with the superiority of their wheels. Reverberating furnaces are used exclusively, and the flame never comes in direct contact with any portion of the wheel. The maximum intensity of heat is at the center of the wheel, and the furnace so arranged that the heat is transmitted regularly and gradually and thus all portions are brought to the welding heat at the same time, insuring that no parts are injured by being overheated or an imperfect weld caused by others being underheated. After the wheel has reached a welding heat it is lifted from the furnace and placed in a die on the anvil of the steam hammer. This die forms a mould for one half of the wheel, and another die fastened to the hammer head forms the other half. A few blows of the hammer are given the wheel, after which it is again heated and hammered, in order to insure all parts being perfectly welded. After the wheel has left the hammer it is cleaned of the fins, then passes to the turning and boring mills, after which it is ready for use.

The process used for the manufacture of driving wheels is very similar to that of car wheels. The rims are rolled and welded, and the spokes are stamped out to their finished shape under a steam hammer. The hub is formed by the inner end of the spokes; the different parts are then laid together, and a pile of iron of the proper dimensions for making the counterbalance and crank pin hub are laid in their proper respective positions. The wheel, while in this condition, is placed in a furnace, heated to a welding heat, placed in a die and struck several blows by the steam hammer, the same as with the car wheels. A second and sometimes a third heating and hammering is given each wheel before it is finished.

Several different types of wheel are manufactured by the company, practically all of which have been the outgrowth of the process described.

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A HIGH SPEED ELECTRIC LOCOMOTIVE.

The first electric locomotive of any considerable size in the United States, and what is said to be the first practically operative high speed electric locomotive in the world, adapted to the steam railroad, has recently been completed at the Lynn works of the General Electric Company, and will shortly be exhibited at the World's Fair. Its completion marks a distinct advance in electrical development.

It is a 30 ton locomotive, designed for a normal speed of 30 miles an hour, primarily intended for operation on elevated railways, and for passenger and light freight traffic on less important steam roads. It is of compact construction, solidly and substantially built, and runs on four 44 inch wheels. Its dimensions are: 16 feet 6 inches long, 11 feet 6 inches high, 8 feet 4 inches broad, having its drawbars 2 feet 6 inches from top of rail, the Manhattan Elevated Railroad standard height. The drawbar pull is calculated at 12,000 pounds.

The propelling power is furnished by two electric motors of especial design and construction, each axle being provided with one motor. The motors are gearless, and are supported on spiral springs resting on the side frames of the locomotive truck. This method of suspension leaves the wheels free to adjust themselves to the irregularities of the roadbed, and consequently the wear to both tracks and motors is diminished.

The motor fields consist of massive iron castings, to which the hollow field spools are bolted. The armatures are of the iron-clad type, having each separate winding embedded in a mica-lined slot cut into the curved surface of the laminated iron armature body. The axles of the locomotive pass through the hollow shafts on which the armatures are mounted. These shafts rest in bearings of the motor frame, and are connected to the axles by universal couplings, which allow of freedom of motion in all directions. The commutators are of massive construction, and there are four sets of brushes to each commutator.

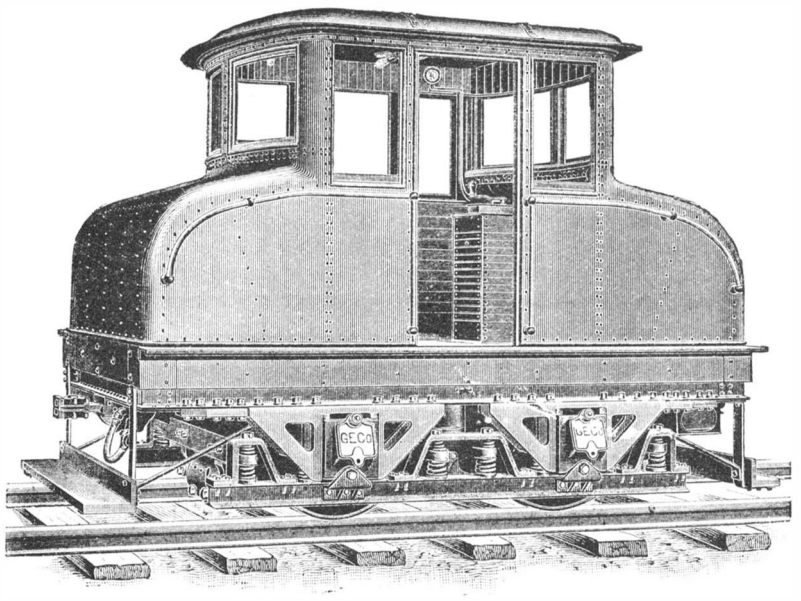
The motors are controlled by means of a series parallel controller, set up in the interior of the cab. This device embodies all the latest improvements made in this type of apparatus by the General Electric Company. Under test it is found that the series parallel controller allows of a more gradual and easier starting of the electric motor and the speed can be more delicately and instantaneously controlled than in the case of the steam locomotive.

The truck, suspended from the journal boxes, is constructed of heavy I beams, and forms the foundation for the locomotive cab, of sheet iron, of symmetrical design, and so curved off as to diminish the atmospheric resistance, as far as possible. The interior is finished in hard wood. Two sliding doors are placed at each side of the cab, and the windows are so arranged as to permit of an unobstructed view in all directions. There is ample space in the cab for the motor man's movements, and it affords him considerably better protection than that usually vouchsafed the steam locomotive engineer.

The air for the brake is supplied by a special electrical air compressor, which also operates the whistles. This air pump has an oscillating cylinder of 6 inches diameter, with a 6 inch stroke, supplying 6,000 cubic inches of air per minute at 70 pounds pressure. The motor is similar to the N.W.P. 2½ in general appearance, but is wound for a higher speed. The normal speed of the armature shaft is 675 revolutions and of the crank shaft of the pump 110 revolutions. The dimensions of the air compressor are, length 41 inches, width 16½ inches, height 25 inches. The pump motor is controlled by a special rheostat. This, by an intermediary device, is automatically regulated by the air pressure.

This locomotive has been designed for a normal speed exceeding 30 miles per hour. The use of these locomotives over very long distances is at present limited only by the cost of long lines of electric feeders, and until the problem offered by this condition is solved, restriction of its employment must necessarily exist. But for places comparatively near each other and where traffic is dense—the denser the better—the electric locomotive is peculiarly adapted, for here all the advantages of electric propulsion are available, unhampered by the extreme expense involved in long feeder lines.

The evolution of the use of the electric locomotive will probably follow along the lines dictated by expediency and favoring conditions. At first they will probably be used in elevated railroad service, and in New York, Brooklyn, and Chicago alone their advent will be hailed with a feeling of gratitude. They will then probably be adopted as feeders to the trunk lines, both for freight and passenger traffic, and to operate short suburban lines where a rapid, efficient service is requisite. Their peculiar fitness for switching purposes will advance their use another step, and then slowly, as the different problems presented are overcome, it is expected that they will invade the province of the trunk line steam locomotive, when it is hoped the millennium of railroad travel will be within the realities of life.



WORLD'S COLUMBIAN EXPOSITION—HIGH SPEED ELECTRIC LOCOMOTIVE.

THE INTRA-MURAL ROAD AT THE GREAT EXPOSITION.

The Intra-mural road at the Columbian Exposition is a particularly attractive study, because of its intimate relation to the subject of rapid transit.

The railway is three and one-tenth miles long, it is double track its entire length and has a loop at each end. The entire superstructure is of wood. The foundations are of concrete placed four feet below the surface. On this concrete were placed cross sills into which were framed two posts of yellow pine, each post being securely pinned and braced. Each post is twelve inches square and posts are placed twelve feet from center to center. The spans of the structure are generally about twenty-five feet. Steel girders are strung along the superstructure and form a foundation on which the ties are laid. The height of the structure varies from twelve feet to twenty-seven feet. There is very little grade throughout the entire length of the line, one and a half per cent being the highest. The rails used are of the ordinary steam railway type, and weigh sixty-five pounds to the yard.

This much of the structure is of ordinary construction. The cars, as will be seen from the illustration, are open and of a new and peculiar type. Each car is forty-seven feet long and has a seating capacity for ninety-six people. It is painted a dark color, with the word "Intra-mural" across the top. Seats run transversely across the car as in the ordinary open street car, but gates are provided on each side which are controlled by a lever convenient to the conductor. As a protection in case of storm or wind, curtains are provided. Each car is fitted with air brakes of sufficient power to stop a train running at a maximum speed in about four hundred feet. The cars are mounted on two double trucks, and are lighted by electricity for evening service. There are fifteen trains of four cars each and three extra motor cars to provide against mishaps to any of the other motor cars. The leading car on each train is the motor car. In construction and design the motor car does not differ from the others in any respect except in the matter of electrical equipment and that the trucks are somewhat heavier. There is an electric motor of 133 horse power capacity on each axle, thus giving the total horse power of each motor car 532, or considerably more than twice as much as the steam engines on the elevated roads in New York or Chicago have. Having so much horse power as this, one of these motor cars can pick up its train and readily attain a speed of ten miles an hour in twice its length—a very important consideration when stations are so near together as is the case with this road, and where the headway between trains is so short.

The electric current is supplied by an ordinary rail of sixty-five pounds weight, which is laid on the sleepers outside of the track upon which the cars run. This conductor is properly insulated and the rails are bound to each other by copper plates, thus giving an efficient electrical conductor. Over about two-fifths of the length of the road two rails side by side serve as conductors to prevent any drop in potential. Current is taken from this rail by means of a sliding shoe made of copper which is held in close contact with the rail by means of a spring. The return current is through the iron part of the structure, the tracks and the girders. The main purpose of the engineers in designing the road has been to secure the greatest amount of efficiency at a minimum cost, as the road is constructed to make money and not to demonstrate a principle. The power house which supplies the current for operating the road is a commodious structure covered with staff. At the south end of the building on a level with the ground is the boiler room in which there are ten water tube boilers of three hundred horse power each. On the same level with the boilers under the main part of the building are the condensers, feed pumps, etc., used in connection with the engines. The engine room is in what might be called the second story. Between it and the boiler room is a gallery from which the work of the plant can be observed.

The engine foundations are on solid concrete and heavy timber and are amply strong. The engine equipment consists of one Allis two thousand horse power compound engine, which is coupled direct to a Thomson-Houston 1,500 kilowatt

THE WORLD'S COLUMBIAN EXPOSITION—LOOP OF THE INTRA-MURAL RAILWAY.

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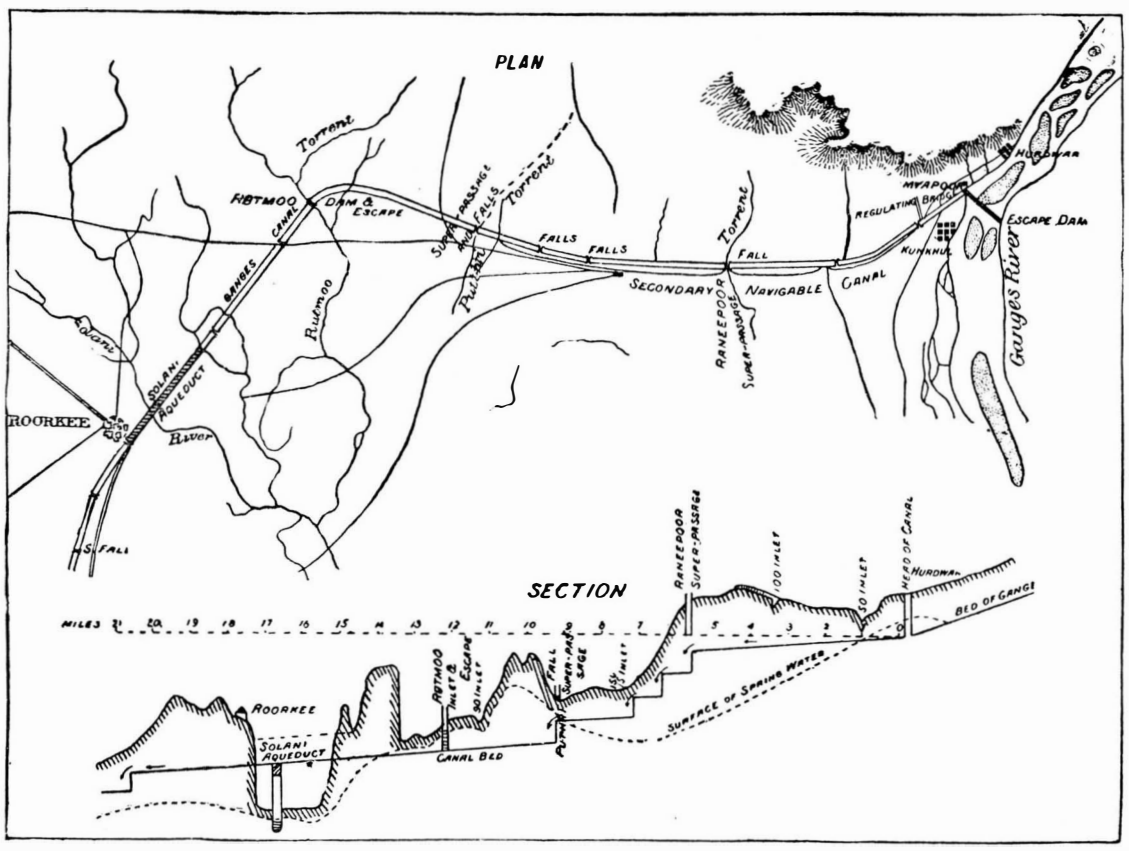
multipolar railway generator, three compound engines each of 750 horse power, one a horizontal, direct-connected to a Thomson-Houston multipolar railway generator of 500 horse power capacity, another a vertical engine direct-connected to a similar generator, and a third belted to one of these generators. There is also a four hundred horse power high speed compound engine direct-connected to a two hundred horse power Thomson-Houston railway generator. The switchboard is on the north side of the room, and from it the operator commands full view of all the machinery. The armature of the 1,500 kilowatt generator is probably the largest one in the Exposition service. It was built up on the engine shaft. The generator is fifteen feet in diameter, while the commutator is seven feet in diameter, and twelve clusters of carbon brushes with ten brushes in a cluster bear on it.

There are ten stations on the road. The first one is at the loop at the south end of the grounds, the others are in the following order: The Forestry building, the Colonnade, which is between the Palace of Mechanic Arts and the Agricultural building, the Railway Terminal Station, the Transportation building adjoining and connecting with the station of the elevated road from the heart of the city, the 62d Street entrance to the grounds, the 59th Street entrance to the grounds, the 57th Street entrance, the Iowa building, and at the loop at the north end of the line adjacent to the Fisheries building and the United States government building.



PLAN AND CROSS SECTION OF GANGES CANAL, HURDWAR TO ROORKEE.

IRRIGATION IN INDIA.

The twelfth annual report of the U. S. Geological Survey, J. W. Powell director, contains, among other most valuable matters, a paper by Herbert M. Wilson, C.E., entitled Irrigation in India. It is an account of his personal observations in that country in 1890, during a visit and inspection of some of the principal irrigation works made under the auspices of the survey. The paper forms a volume of some two hundred pages, illustrated with maps and photographs, over eighty in number. We are indebted to the author for a copy. It is full of most interesting and valuable information. We regret that our limited space prevents us from presenting the paper *in extenso*. We can only give a few abstracts, sufficient, perhaps, to convey to the reader an idea of some of the extraordinary works that have been constructed and are being built in India, by the British government, for the benefit of the agriculturists of that great empire.

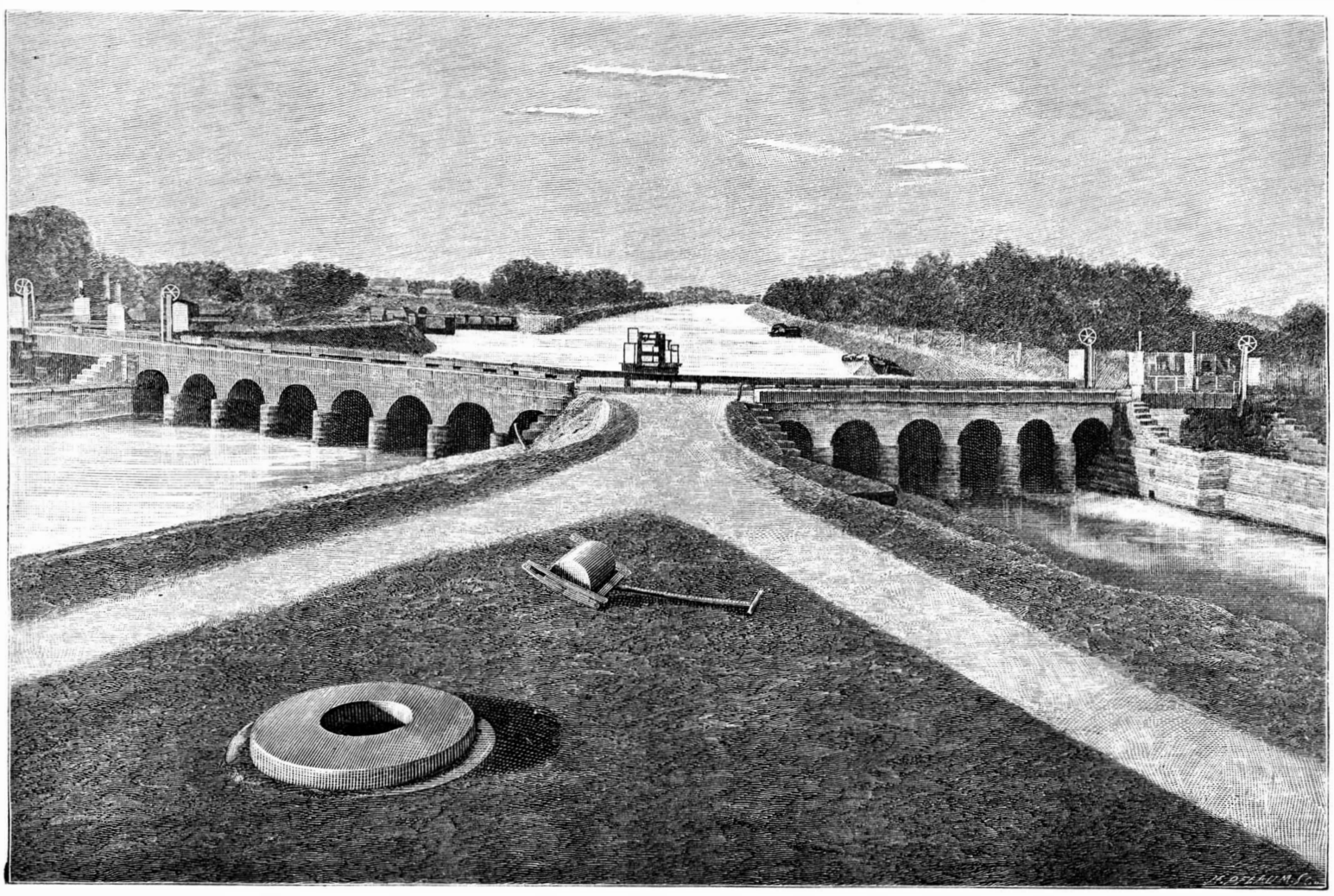
"India," says Mr. Wilson, "stands pre-eminent for her gigantic engineering undertakings. No other country has so vast and so fertile an expanse of territory, with such convenient slopes for the construction of canals, and at the same time such an abundant water supply. In general there is great similarity between the climate and topography of the great northern plains of India and portions of our arid West, especially the eastern slope of the Rocky Mountains and the great California valley. Central India and the Deccan have many features in common with the central arid Territories, particularly portions of northern Arizona and southern Utah. The climate is as similar to that of our central Territories as is the topography."

"The conditions under which Americans must undertake irrigation enterprises are not so different from those exising in India and southern Europe as would at first appear. Any works we may construct must depend for their utilization and revenue on immigration, as they will be largely undertaken in a sparsely inhabited country. A few of the great canals of the Northwest Provinces and the Punjab were undertaken in districts that were sparsely inhabited. These canals are among those of India that have paid the largest interest on the original outlay. Within ten years from their construction the country was fully populated, although the immigration was often from remote portions of India." In 1888 the area of British territory in India was 1,064,720 square miles and the population 269,477,728. The area cultivated was 144,000,000 acres, of which 25,000,000 acres were irrigated lands.

"The irrigation works of India are divided by the engineer into two great classes, (1) gravity irrigation and (2) lift irrigation. The former includes four great heads, namely, perennial canals, intermittent canals, periodical canals and inundation canals. The water supply for these may be supplemented by storage works. This will be treated as a third class. Perennial canals are taken from the rivers the discharge of which at all times suffices for the irrigation of the lands without the aid of storage. Intermittent canals are taken from intermittent streams, the water of which must be stored in order to furnish a constant supply. Periodical canals are taken from streams having an available supply during the rainy season only, and are used altogether in the cultivation of the summer crop. Inundation canals are taken from rivers having a constant discharge of some magnitude, but are fed by those rivers only when in flood. Lift irrigation is chiefly illustrated by wells. Of these there is little to say, although the area irrigated by them is considerable. They are used in a country where labor is cheap, and are valuable adjuncts of irrigation, catching the seepage water from the canals and irrigated fields which otherwise would be wasted. Owing to the cost of labor, it is doubtful if they will ever be used to any extent in America."

"Men, women, and children are engaged alike in the construction of all works. As common laborers women and children receive about 4 cents per day, and men from 8 to 10 cents. Skilled masons and machinists receive from 18 to 22 cents per day, and carpenters and blacksmiths nearly the same."

"There are 34 major works designed to irrigate, when fully completed and irrigation has been fully developed, something more than 10,000,000 acres. Of 5,520 miles of main and branch canals, no less than



THE GANGES IRRIGATING CANAL INDIA—THE GOPALPUR BIFURCATION.

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2,250 miles are navigable. In addition to the 5,520 miles of main canals constructed in these 34 systems, there are 17,135 miles of principal distributaries."

"The gross value of the entire area irrigated in 1888 by all the four classes of irrigation works administered by the government reached the sum of $155,000,000."

Additional works to the value of nearly as much more are projected and in progress.

THE GANGES CANAL.

"This canal is the largest in existence. As at present constructed its head works are situated near the city of Hurdwar, about 20 miles above the railway town of Roorkee. At this point the Ganges issues suddenly from between the foothills of the Himalayas on to the broad level plains. In the first 20 miles of its course (see plan) the canal encounters a considerable amount of sub-Himalaya drainage, and the works for the passage of this drainage and for the reduction of the slope of the canal by means of falls are important. The slope of the river bed in this section is from 8 to 10 feet per mile."

"A short distance above Hurdwar a branch of the Ganges about 300 feet in width separates from the main river and hugging the Hurdwar shore rejoins the stream a half mile below Hurdwar. The discharge of the main river at this point in the dry season is about 8,000 second-feet, a majority of which is diverted by training works and temporary bowlder dams into the Hurdwar channel. This has been deepened and given a uniform slope of 8½ feet per mile to the canal head. At Myapur the canal is taken from the Hardwar channel, the water being diverted into it by means of a weir and sluices across the channel and a masonry regulator at the head of the canal. To the sixth mile the canal crosses several minor drainages, which are admitted by means of little inlets. At the sixth mile it is crossed by the Ranipur torrent, passed over it by means of a masonry superpassage about 195 feet in breadth. In the tenth mile the Puthri torrent, having a catchment basin of about 80 square miles, or twice that of the Ranipur, is carried across the canal by a similar superpassage 296 feet in breadth. The sudden flood discharges in these torrents are of great violence, the Puthri torrent discharging as much as 15,000 second-feet and having a velocity of about 15 feet per second.

"In the thirteenth mile the canal encounters the Rutmoo torrent, with a slope of 8 feet per mile and a catchment basin half as large again as that of the Puthri. This torrent is admitted into the canal at its own level. In the side of the canal opposite to the inlet is an open masonry outlet dam or set of escape sluices. In the canal just below this level crossing is a regulating bridge by which the discharge of the canal can be readily controlled; thus in time of flood, by opening the sluices in the outlet dam and adjusting those in the regulator so as to admit into the canal the volume of water required, the remainder is discharged through the scouring sluices, whence it continues in its course down the Ranipur torrent.

"In the nineteenth mile, near Roorkee, the canal crosses the Solani River and Valley on an enormous masonry aqueduct. The Solani River in times of highest flood has a discharge of 35,000 second-feet and the fall of its bed is about 5 feet per mile. The total length of the aqueduct is 920 feet. The banks of the canal on the upstream side are reveted by means of masonry steps for a distance of 10,713 feet, and on the downstream side for a distance of 2,722 feet. For 1¾ miles the bed of the canal is raised on a high embankment previously to its reaching the aqueduct, and for a distance of half a mile below it is on a similar embankment. The greatest height of the canal bed above the country is 24 feet. The aqueduct proper consists of fifteen arches of 50 feet span each. In addition to these great works there are in the first 20 miles of the canal five masonry works for damming minor streams and a number of masonry falls.

"Beyond Roorkee the main canal follows the high divide between the Ganges and the west Kali Nadi and continues in general to follow the divide between the Ganges and the Jumna to Gopalpur, a short distance below Aligarh, where the main canal bifurcates (see engraving), forming the Cawnpur and Etawah branches. The former branch tails into the Ganges at Cawnpur and is 170 miles in length. The Etawah branch is also 170 miles long and tails into the river Jumna near Humerpur. The Vanupshahr branch leaves the main line at the fiftieth mile and flows past the towns of Vanupshahr and Shahjahanpur. It formerly terminated at mile 82½, emptying into the Ganges River, but it is now continued to a point near Kesganj, where it tails into the Lower Ganges Canal. The first main distributaries are taken from both sides of the canal a short distance below Roorkee. The nature of the country offers abundant facilities for escapes from the canals. Five are constructed on the main line, four on the Cawnpur branch, and three on the Etawah branch, besides numerous small escapes to the distributaries."

LOWER GANGES CANAL.

"The Lower Ganges Canal was undertaken as a means of relief or improvement of the Ganges Canal. It irrigates a part of the Ganges-Jumna interfluve that was originally intended should be commanded by the Ganges Canal proper. The work comprises a masonry diversion weir at Narora, about three miles below the railway crossing at Rajghat. It relieves the Ganges Canal of 128 miles of the Cawnpur branch and 130 miles of the Etawah branch. It is now considered as a work separate from the Ganges Canal.

"The weir is a substantial one, resting on masonry wells, usually 20 feet deep; the front and rear curtain walls rest on smaller wells. The weir is 3,800 feet long and is 10 by 10 feet in cross section, having a vertical overfall to a paved floor. It is constructed chiefly of brick. The weir scouring sluices opposite the canal head are 42, each 7¼ feet wide. The regulator at the canal head is constructed of masonry and has thirty openings each 7 feet wide. The weir crest is 7½ feet above the sill of the canal, and this can be raised to 10 feet by means of shutters. For the first 26 miles of main canal the bed is 216 feet wide; the full supply depth is 10 feet and the slope one-tenth of a foot in 1,000.

"In the first portion of its line the canal is compelled to follow the low river bottom for some distance before its grade enables it to surmount the banks and reach the summit of the interfluve. In this low reach the canal is threatened constantly by the encroachments of the river, and extensive river training works are necessary to preserve its integrity. These extend for a distance of 4 miles above the canal head and 15 miles below, and consist chiefly of long earthen groynes or embankments, sometimes 2½ miles in length, projecting into the stream at right angles to its course and protected at the end by loose rock noses. The total length of the main canals is 564 miles. There are 2,021 miles of distributaries and the total length, including escapes and drainage cuts, amounts to 2,992 miles."

Electricity and the Art of War.

This was the title of an able article in a recent number of the *Journal of the U. S. Artillery*, and in the last number, January, the comments and remarks of various officers upon the subject are given. Among them is the following by Second Lieutenant George O. Squier, Third Artillery, who says:

Some recent experiments abroad by Captain Charollois on the use of a field telephone outfit for military operations indicate that it has great possibilities as a means of communication in the field. Captain Charollois uses a bi-metallic wire, with steel core surrounded by copper. Thus it is not easily oxidized, and has great strength for a given cross section. This wire is unwound naked upon the surface of the ground, the earth return being completed through the operator himself, or his horse in case he is mounted. The small magnetic receivers can be used as the wire is being paid out on the ground, and this constant communication is kept with the starting point as the line progresses. By the use of such small wire the entire material for a line of one mile weighs less than five and a half pounds. Each reel carries 10,000 feet of wire, and is conveniently and compactly strapped to the soldier as a part of his equipment. On account of the extremely minute currents required in telephony, the only limit to the smallness of the wire, and its consequent weight for a given length, is the fear of breaking while it is being laid. Cavalrymen, or infantry on bicycles, could establish a line with great rapidity. In some recent experiments in the field, a 14 mile line was completed in five hours and taken up in one hour; and the passage of a division of cavalry over the wire did not interrupt the communication of a dispatch that was being sent at the same moment. No batteries are required; no poles of any kind; no heavy, cumbersome wire to be strung, and any one can operate.

In view of the above, and that we are now talking between New York and Milwaukee, there is but little doubt that the telephone is the instrument both for the field and for permanent lines.

The writing telegraph, when perfected, will undoubtedly have its important *role*, as by its use maps, plans of battles and fortifications, and drawings of all kinds can be reproduced with accuracy at any distance.

Passing to the use of railroads in the mobilization and supply of armies, those familiar with recent street railway progress believe that the steam locomotive must give way to the electric motor for passenger service, and also that with this change a speed of one hundred miles an hour will be the rule and not the exception. An electric line is now under construction between Chicago and St. Louis, which is to make the trip in three hours.

The suggestions of Lieutenant Parkhurst as to the applications of electricity to the modern sea coast fortification are excellent, and instead of being, as some may think, the predictions of an enthusiast, they are not as progressive as the present state of electrical science warrants.

In regard to the security of the main power plant against the long-range fire of the enemy's guns, it is remarked that there seems to be no limit as yet to the distance which electrical power can be economically transmitted. We have recently before us the Lauffen-Frankfort line in Europe, where 300 horse power was transmitted 112 miles at a tension from 16,000 to 30,000 volts, at an efficiency of 74 per cent. As soon as we obtain a perfectly satisfactory alternating current motor, I see no reason why electrical power cannot be transmitted and converted into useful work at distances much greater than the above.

Electricity threatens to revolutionize our whole heavy artillery organization. With an enormous engine of war, weighing many tons, costing thousands of dollars, which can, however, by the application of results *already accomplished* in the industrial world, be lowered, raised, aimed, and fired by the movement of simple levers in the hands of a gunner—does not this point to *fewer* men and *more skilled* men in our organization?

The dozen men in a detachment required for the doomed "heave and embar" system must be replaced by not more than half that number of carefully trained cannoneers. Each round fired from our new 12 inch rifles will cost $217, the gun itself costs $52,365, and these amounts in conjunction with the cost of the carriage, and the limited life of the weapon, compel us to adopt that means of control which insures the most rapid, accurate, and reliable service.

Granting that the modern fortification will be equipped with an elaborate electrical plant, ought we to rely upon civilian electrical engineers to design, install, and care for the same? This brings up a subject of policy of which I have been firmly convicted for the last five years, and which is strengthened more and more as time goes on. Electrical science has reached the theoretical stage—that, given the set of conditions which the motor is to fulfill, and which in sea coast matters the artillerist alone fully understands, the design of the machine to do this particular work can be made with accuracy, *e. g.*, speed under variation of load, field windings for perfect control, and the size of every minute part can be calculated in the office, and when assembled in the workshop it will do the work required near perfection.

We have only to look at our new navy for a practical illustration of the way things are drifting in this regard. Every modern cruiser now has its officer in charge of all electrical matters on shipboard, and the generators and motors already in use are specially designed for conditions afloat. In like manner each group of guns ashore, with its electric lighting system, search light system, range finding system, generators, and motors, will of necessity be under the supervision of an electrical engineer directly responsible to the senior artillery officer in command. If present conditions point to anything, they seem to me to point to the necessity of the following:

The War Department should speedily educate a limited number of officers as electrical engineers at our best institutions of learning. The word "speedily" is used because one cannot become an electrical engineer in six months, nor yet in one year, and he certainly cannot be created at pleasure by a general order from the War Department.

I am aware that objection would be made by some to such details; the applicant is supposed to desire to shirk his legitimate battery duties, and what not; but such reasons seem to me on too low a plane to merit serious consideration. The weeding process of requiring periodical reports of the work accomplished, and the efficiency reports already in vogue, would insure the details being given to those who would make the most of them for the department.

Thanks to the foresight of the General Commanding the Army, officers of artillery have recently been sent to our principal arsenals to co-operate with the Ordnance in the manufacture and testing of our modern guns. With half a dozen expert electrical engineers at Sandy Hook, and the sea coast gun carriage factory at the Watertown arsenal, co-operating and in perfect harmony with the ordnance experts already at these places, to design, test, and work out step by step the details of the plan, I doubt not that rapid progress would be made toward the selection of type carriages for our new guns and mortars, and we no longer would be threatened with the condition of possessing finished weapons with no carriages on which to mount them.

Inventor Harvey's Royalties.

Many who have speculated on the immense fortune which Mr. Harvey will realize from his process of treating armor plate will be surprised to learn that his profits from the United States government will be only about $100,000. The amount of royalty which Harvey receives for the right to decarbonize armor plates by his method of treatment is fixed at a half-cent a pound. Nineteen thousand tons of armor have been contracted for and less than half will be Harveyized. It is the intention of the Navy Department to increase the order for Harveyized armor plate as much as possible; this is the natural result of the remarkably successful trials recently held at Indian Head.

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THE PURIFICATION OF DRINKING WATER BY MEANS OF ELECTRICITY.

The reappearance of that dreaded scourge, cholera, in Europe, and the chance that it may be transmitted to this country, has naturally led our medical authorities to exert themselves to the utmost to render sanitary conditions as perfect as possible. It is generally recognized that cholera is due to a germ which finds its way into the stomach and intestines, being usually conveyed through the medium of the drinking water supplied in cities. It was, indeed, established beyond doubt that the terrible plague of Hamburg last year was due to the pollution of the river Elbe, Hamburg's old source of water supply. While it is true that the water can be sterilized and made safe for drinking by boiling, the fact remains that the process, simple as it is, is applied in but a small minority of cases. This is well recognized among sanitary authorities, with the result that the conclusion has been reached that true relief must be looked for in the purification of the water supplied before it reaches the consumers.

It has been noted that the pollution of drinking water for city purposes is most frequently due to sewage, which is either led directly to the waters serving as a source ef supply or finds its way into such sources by percolation through the earth. In either case, unless measures be taken to destroy the disease germs or other compounds, usually of a nitrogenous nature, the result is inevitably a large increase in zymotic diseases. The purification of sewage has, therefore, attracted the attention of sanitarians for some time past; but up to the present little, if anything, has been done looking toward a satisfactory solution of the problem.

At the same time, the methods adopted for the purification of the water supply have been not less numerous, and several have been tried in actual practice, among them aeration. It is doubtful, however, whether the results thus far obtained justify the expectations with which they were hailed, so that there still remains a wide field open for improvement.

It was a condition of affairs similar to that outlined above which for some time has caused much uneasiness to the inhabitants of New York City, and the local medical authorities, at the head of whom is Dr. Cyrus Edson, have been unceasing in their efforts to devise means for improving the condition of the water supply of New York City. One of its chief sources of pollution was found to be the sewage outlet at the village of Brewsters, a little town situated some twenty miles from New York. At this place the sewage drained into a stretch of marsh situated at an elevation, and so located that the percolation reached one of the streams forming the water supply for New York City. These marshes had in themselves already grown to be a nuisance and a menace to the health of the inhabitants of the town, and hence the local authorities were also greatly interested in any means which would afford them relief. On looking up various methods with this end in view, Dr. Edson decided that the simplest way out of the difficulty was the thorough purification and rendering harmless of the Brewsters sewage; but the difficulty of effecting a thorough purification with the means ordinarily employed for that purpose, involving the use of expensive chemicals containing hypochlorites and chlorides, led him to the adoption of a method proposed by Mr. Albert E. Woolf, of this city.

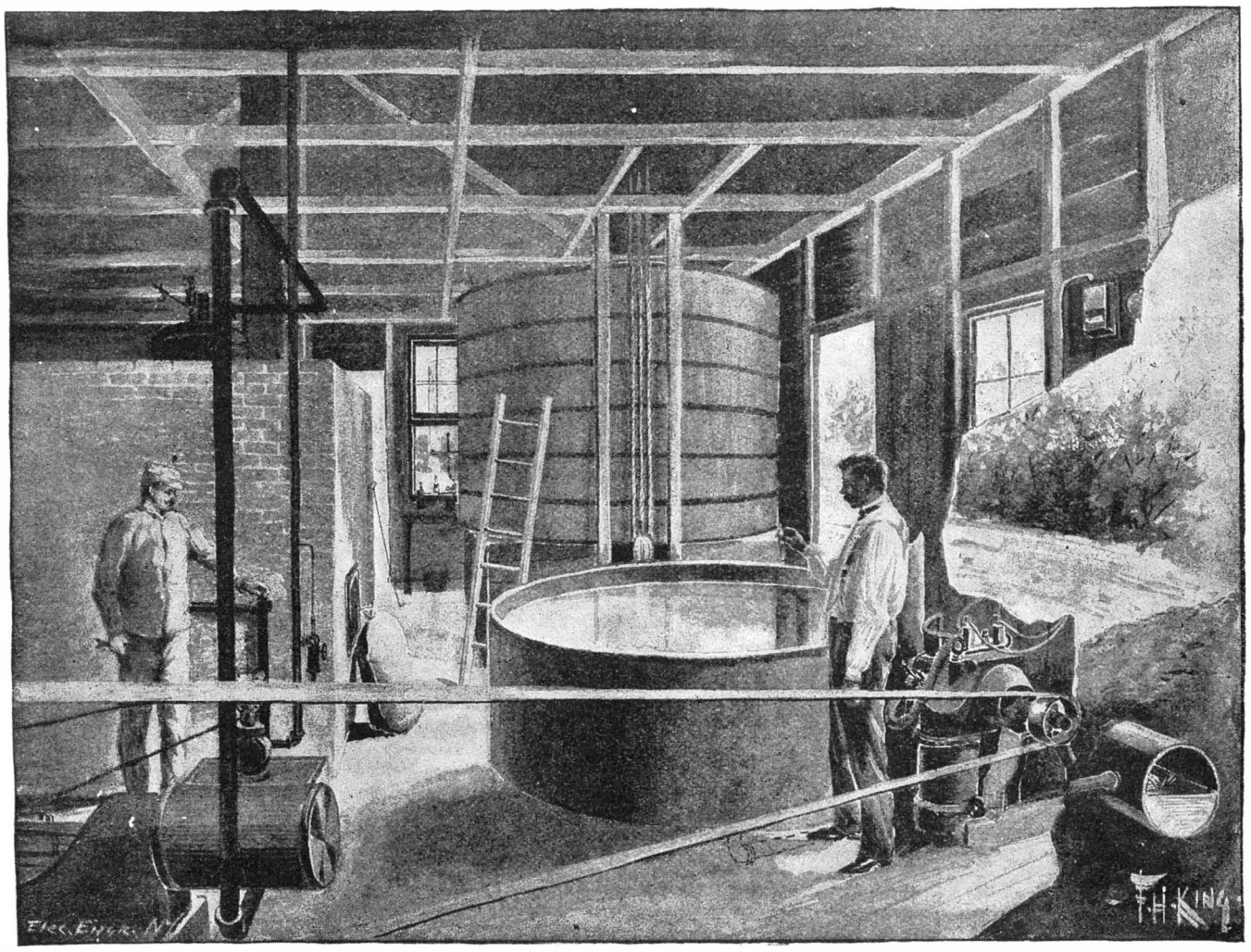
Mr. Woolf, whose work in storage batteries has already been mentioned in these columns, has recently developed a method of obtaining a cheap disinfectant by electrolyzing sea water.

The principal solids held in solution in sea water in the Atlantic Ocean are the following, the figures denoting parts in 100:

Chloride of sodium	2·7558
Bromide of sodium	0·0336
Sulphate of potassium	0·1715
" " lime	0·2046
" " magnesia	0·0614
Chloride of magnesia	0·3260
Total	3·5519

By passing a current through the sea water the chlorides, bromides, etc., are converted into hypochlorites, hypobromides, etc., and other compounds of a more or less complex nature are formed. When a solution of hypochlorite of sodium is brought into contact with organic matter, a decomposition at once takes place. While it is impossible to state just what the reaction would be, it is probably as follows: Part of the chlorine in the hypochlorite replaces a part or the whole of the hydrogen in the organic substance. Another portion unites with the liberated hydrogen, and, as in bleaching, ozone is produced, which, in its turn, acts on the organic matter. In other words, the organic material, be it organized, as in the lower forms of vegetable life (viz., bacteria, etc.), or non-organized, as in the solid or suspended matter of sewage, is decomposed, and if sufficient hypochlorites be present, the organic matter is permanently disinfected.

In the preparation of the Woolf disinfecting material it is, of course, essential to employ electrodes which are not decomposed by the electrolyzing action, and for that purpose Mr. Woolf employs a positive electrode consisting of copper coated with platinum; while as a negative he employs carbon.



THE WOOLF ELECTRICAL APPARATUS FOR THE PURIFICATION OF WATER.

As already remarked, the plant for the production of the new disinfectant has been established at the town of Brewsters, and our engraving shows the interior arrangement. It consists of a steam plant operating a Zucker & Leavitt dynamo, which is capable of furnishing 700 amperes at a potential of 5 volts. The engine has a capacity of 15 horse power. Close beside the dynamo is an electrolyzing tank, which has a capacity of 1,000 gallons and which is fed from a 3,000 gallon storage tank beside it, and elevated above it so that the solution flows to the electrolyzing tank by gravity.

The electrodes which rest on the bottom of the tank are composed of three platinum plates of the nature described above, and four of carbon, the positive and negative plates alternating. The carbon plates present a surface of 12 by 12 inches and are 1 inch thick. The arrangement, as will be seen, is such that the process is a continuous one. The flow of the solution is so timed that the salt water is electrolyzed to a proper degree, and then overflows directly into a pipe leading into the sewer.

This plant of 15 horse power capacity is far in excess of that required to disinfect thoroughly the entire sewage of the town of Brewsters, but was designedly arranged so that it would eventually be able to take care of an increase of population amounting to 30,000.

The effect of the electrolytic disinfectant on the sewage outlet at Brewsters is of a most marked character. The offensive odors arising from the marshes no longer exist, and the sewage shows a marked diminution in the nitrites present. It is also noticed that the green algæ and other organic matter upon the surface of the marshes, and which had usually collected on the retaining walls, has become bleached.

As showing the value of this electrical disinfectant produced by the aid of electrolysis, it is interesting to note some recent reports made by the officers of the Health Department of New York City. Dr. Cyrus Edson, chief of the medical staff of the Board of Health, states that in a series of experiments on anthrax spores and staphylococcus pyogenous aureus, in all cases save the exposure of anthrax for one minute to a 10 per cent solution, the liquid exercises a marked inhibiting effect on the growth of the micro-organisms employed. It has also been shown that the solution is an effective agent for the destruction of cholera spirillum. Experiments made show that no cholera colonies are developed after an exposure of 30 seconds to the disinfecting agent. Tests of the Woolf disinfectant show that it equals in strength a 1 per cent solution of chloride of lime. In the latter there are 175 grains of available chlorine to the gallon, while in the Woolf disinfectant 186 grains were found to be available.

In the matter of cost, however, the great value of the Woolf disinfectant will be apparent when it is considered that a 1 per cent solution of chloride of lime costs about 1·4 cents per gallon with lime at 6 cents per pound. The estimated cost of the electrolyzed sea water, however, is only 10 cents per 1,000 gallons. Reckoning on this basis, therefore, Dr. Edson shows that its price per gallon may be 0·01 cent; in other words, 140 gallons of electrolyzed sea water will cost only as much as 1 gallon of a 1 per cent solution of chloride of lime. Comparing the cost with that of bi-chloride of mercury, the disproportion is in the ratio of 100 to 1 in favor of the Woolf disinfectant; while a 5 per cent solution of carbolic acid costs from two to three hundred times as much. Besides this, the two latter are extremely dangerous when handled by inexperienced persons. From this standpoint, electrolyzed sea water is harmless; indeed, we have seen the inventor drink it as one would spring water, without any apparent ill effects. The experiments made thus far have been so successful that Dr. Edson has recommended that steps be taken to locate a disinfecting plant in New York City, and no doubt the plan will soon be carried out.—*The Electrical Engineer.*

The New Regulation Bullet.

The Frankford arsenal is now making ammunition for the new "United States magazine rifle," caliber 30, with a 220-grain bullet, the weight of the bullet used at present being 500 grains. The rifle is a modified Krag-Jorgensen rifle, with which the troops of Denmark are armed.

Experiments made at the Frankford arsenal demonstrate that a nickel-steel covered, unlubricated cartridge of the new type is better than the old copper case with lubricated bullet. The velocity of the new 220-grain bullet of 30-caliber is 2,000 feet per second, while the velocity of a 45-caliber, 500 grain bullet is only 1,300 feet. The penetration is remarkable. A small caliber bullet of the new type fired at oak timbers placed lengthwise, penetrates 30 inches at 30 yards range, while the present bullet will only penetrate 4 to 5 inches at the same range. The accuracy of fire with the new bullet is very remarkable. The new bullet is called a humanitarian bullet, for the reason that there is every chance of the bullet passing directly through a bone without shattering it. It is possible that our army may now have the best bullet, as our navy has the best armor plate in the world.

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RECENTLY PATENTED INVENTIONS.

Engineering.

BOILER FEEDER.—Augusto S. y Barcon, Corunna, Spain. A float in a regulator connected by a pipe with the boiler at the normal water level actuates a valve to interrupt the connection between the regulator and the boiler, a filling receptacle furnishing the feed water being connected with the boiler and the regulator, while valves in the connecting pipes are adapted to be automatically closed by the reduction of pressure in the filling receptacle and in the regulator when the admission of steam to the latter ceases. The whole apparatus is of simple and durable construction, and is arranged to measure and regulate the quantity of water to be made into steam.

FURNACE TAP.—Edward P. Mathewson, Pueblo, Col. This invention provides an improvement on a former patented invention of the same inventor, the improved tap being readily applicable to any furnace now in use, and being so arranged as to prevent any undue chilling of the matte. The tap has a casing in communication at its rear open end with the interior of the furnace, the front of the casing having an inward extension containing the matte hole, which is arranged below the bottom edge of the water-cooled bosh, a cleaning hole being also located above the extension at the front, and one side of the casing being formed with a slag hole.

STUFFING BOX.—George H. Hitchcock, Danville, Ill. The steam pressure is, according to this invention, made to insure a steam-tight joint between an adjustable stuffing box and the cylinder head. The piston rod aperture is of greater diameter than the rod, and has a counterbore in the base of which are held two expansible rings of greater internal diameter than the piston rod, and having beveled engaging surfaces, the lower edge of the outer ring being exposed to the steam within the chamber formed by the rings, while the stuffing box is secured to the cyli der head with its lower end closing the upper end of the steam space formed by the rings.

CENTER SEAL OF GAS PURIFIER.—John Hearne, Boston, Mass. This invention provides a simple and easily operated seal which may be made of a capacity to connect with any necessary number of purifiers. It has a gas inlet and outlet arranged in such a manner that the gas may flow unobstructedly through the seal, and has a number of supplemental and easily operated valves by which the gas may be directed to any desired number of purifiers, or may be cut off from one or all of them without interfering with its flow through the seal, enabling the operation of purifying to be carried on through some of the purifiers when the others may be out of repair or unfit for use.

Electrical.

ARMATURE.—Joseph J. Smith and George W. Findlater, Jamaica, N. Y. A central ring has radially extending arms carrying circumferential bands, one of the bands having an end flange, while a series of removable bobbins is held between the arms and within the band, the bobbins having their feet dovetailed into the ring. Revoluble washers are pivoted on the ring to overlap the feet of the bobbins, the washers having one flat edge and being secured by a fastening device. A cheap and simple form of armature is thus formed, the bobbins being easily removable and each carrying a coil, the several coils being readily connected and disconnected, so that in case one is burned out it may be easily removed and another inserted in its place.

Railway Appliances.

SWITCH MANIPULATING DEVICE.—Daniel L. Boland, New York City. This device is especially adapted for use upon street car tracks, and is to be operated from the car before it reaches the switch, being also capable of manipulation by a rapidly moving train some distance from the switch. Levers located beneath the car are adapted to depress hinged platforms between the tracks, each platform being connected by a link with a lever attached to a shaft connected with a switch lever, by means of which the switch may be thrown in either direction in advance of the car.

Mechanical.

WRENCH.—Frederick S. Seymour, Lake Geneva, Wis. This wrench comprises two jaws having a hinged connection, one jaw overlapping the other and one overlapping end having a cylindrical surface, a cam pivoted upon one jaw engaging the overlapping cylindrical surface of the other jaw, a handle being connected with the cam. The two jaws are approximately L-shaped, the cam engaging the rear member of the movable jaw to swing it on its pivot, so that the wrench may be quickly applied to a nut of any size.

NUT LOCK.—Robert Holmes, Canon City, Col. Two sleeve nuts of equal diameter and externally threaded left handed have internal right hand threads to engage the same bolt head, there being a squared reduction on each end of the nuts to fit the same socket wrench, while two similar jam nuts, hexagonal externally, are internally threaded to fit on the sleeve nut threads, and ratchet teeth in a continuous circle are formed on an end face of each jam nut. The improvement is applicable to lock nuts on all kinds of machinery, and may be easily adjusted to lock or release the nut.

PRINTING PRESS.—Oliver S. Bowman, Salt Lake City, Utah Ter. This is a job press designed to give a direct and even impression without hinge motion, and provided with a simple and effective inking device, and a quick and reliable means of feeding. Means are also provided to facilitate "making ready" in a short time, and the printed sheets are delivered by grippers upon a table at the rear of the press.

Agricultural.

SEED PLANTER AND FERTILIZER DISTRIBUTER.—Charles R. Reid, Heidelberg, Miss. This is a machine in which the plow may be wholly or partly lifted from the ground without interfering with the planting or distributing mechanism, which is driven from the main supporting wheel. The hopper and feed wheel are especially adapted for planting cotton or like seed and for distributing fertilizer, with a continuous delivery, and the seed box and driving mechanism are spring supported. Different styles of hopper may be quickly and easily connected with or detached from the spring carriage. The machine is inexpensive to manufacture and is designed to work well on ground of any character.

WEEDER AND CULTIVATOR.—Charles C. Platt, Waverly, Kansas. A machine especially adapted for working listed corn has been designed by this inventor, the runners of which are readily adjustable toward and from one another, while the cultivators are independently adjustable vertically and laterally, the frame carrying the cultivators being also readily raised and lowered. The weeders consist of two blades at each side of the machine, one blade shorter than the other, all being rearwardly inclined, but the longer one having a downward and the shorter an upward inclination, to cut the weeds from the tops and the sides of the ridges. One set of cultivators is designed to operate upon the ridges while another set loosens the ground at each side of the row of corn and within the space between the runners, the plants being protected by shields.

THRASHING MACHINE DEVICE.—George W. Rucker, Belle Plaine, Iowa. This is a light and simple feeder attachment which can be folded over upon the thrasher when not in use without removing a belt. A conveyer is located beneath the delivery end of a series of carrying belts, a knife-carrying drum revolving above, while a series of stationary knives is located in the path of revolution of the drum, there being stripping or cleaning devices for the belts and knives. The feeder is designed to deliver any kind of grain fed to it, and cut both the bundles and the grain, the latter being passed to the thrasher without loss.

ANIMAL SHEARS.—Charles and Harry Burgon, Sheffield, England. This invention relates to improvements in sheep-shearing machines formerly patented by the same inventors, and provides a more efficient and durable anti-friction bearing as a substitute for the ball bearings heretofore used about the main pivotal axis of the cutter-driving lever, providing also means for adjusting the pressure of the top cutters upon the comb, applied to act directly upon the cutter-driving lever through the medium of the anti-friction bearing.

Miscellaneous.

LADDER.—John Splann, Athens, Pa. This ladder may be conveniently used as an extension ladder, a step ladder or a horse to support a staging, being quickly convertible from one kind of ladder to another, and being cheap, strong and durable. It comprises two sections, the upper section sliding between the side rails of the lower section, and each section carrying a windlass, the cable connecting which is passed over guide pulleys on the lower and upper portions of the lower and upper ladders, and the upper section being raised by winding the cable upon the windlass.

FENCE.—John S. Hamilton, Marysville, Ohio. This is virtually a metal fence in which each post is anchored by a base block below the surface of the ground. Each post is formed of a strip of metal bent into strap form, making a pocket at the bottom to receive the base block, the parallel uprights of the posts being stiffened by spacing pieces and tension arms for the stretchers. The tension arms have notches to engage the loops of wire stretchers.

HOLDER FOR BOUQUETS, ETC.—Herman C. Wiedenmann, Philadelphia, Pa. This holder comprises a clasp having a body with an opening on one side, integral arms extending from the sides of the opening, and an adjustable fastening device to affix the position of the arms and fasten the clasp to a support, a second pair of arms forming an open loop to receive and support an article. The holder is adapted to support bouquets, flag sticks, parasols and other light articles, and may be easily attached to the frame or handle bar of a bicycle or other support.

NAPKIN RING.—Ernest Drevet, New York City. Two curved bands overlapped at their ends, which are connected by pivots, carry a clasp pivoted to one of the bands. The ring may be made up in many pretty designs, and may be opened wide or only partially opened to receive the napkin. It is also adapted to serve as a hook to suspend the napkin from the collar to protect the bosom.

ARM REST.—Charles S. Rodgers and Charles E. Schudy, Manitou, Col. This rest has on one of its faces a clamping plate, between which and the body of the rest the body of a book may be inserted and held, the clamp being pivoted so that it may be turned longitudinally or transversely on the rest. The rest may be held in firm position even when used in connection with the last or first leaf of a book.

HAME TUG.—John C. Anderson, New Windsor, Ill., (deceased, Arthur R. Anderson, administrator.) This tug is formed of a single looped piece, the rear end of one side made in prongs, the other arm extending between the prongs to their rear ends, while the ends of the prongs have eyes to receive the pintle or pin. The device is light and cheap, makes the joint in the right place for easy action and has very little friction on the staple with which it connects.

ROACH TRAP.—Charles F. Kuntz, St. Louis, Mo. This trap comprises a casing having inclined passageways opening at its sides and near the bottom, the ways leading to an opening in the top of the trap, a stand and bait box being arranged beneath the opening, while inclined flanges within the trap project downward, there being a lid in the bottom of the trap. The trap is cheap and easily cleaned, and when a roach or other bug is in it he cannot get out.

Designs.

HARDWARE ORNAMENTATION.—Leopold Kahn, New York City. This is a band-like metal open-work design, with parallel braid-like borders between which are fern-like figures formed in scrolls, the body portion of the metal swelling outward slightly between the borders.

WATCH CHARM.—Andrew Mulcay, Forsyth, Ga. This charm is in the form of a star, on one side of which is a central figure representing the Western Hemisphere on a disk simulating the globe, while on the other side is a representation of the head of Columbus.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

PHOTOGRAPHY ANNUAL FOR 1893. Edited by Henry Sturmey. 448 illustrations, numerous full page plates, tables. 1893. London: Iliffe & Son. 8vo. Pp. cxc, 790. Price $1.

This annual gives a clear view of the actual progress of the science forthe year. The editorial portion of the work is valuable, many of the latest discoveries in relation to developers, etc., being given. For a number of years this annual has illustrated and described the novelties brought out by the photographic houses both at home and abroad. The plates this year are very fine.

THE GREAT BARRIER REEF OF AUSTRALIA. Its products and potentialities. By W. Saville-Kent. London: W. H. Allen & Co., Limited. Pp. xvii, 387. Price $33.

This superb work is devoted to the life of the Australian reef, its industries, processes of its formation, and similar topics. In the elegance of printing, in its profuse illustrations, and the high character of the same, it is almost unique. The monetary importance of the reef area is indicated by the fact that about $500,000 worth of raw material taken from the reef is annually exported from Queensland. It is considered one of the wonders of the universe. The illustrations of the book are remarkable in effectiveness. They include 48 photo-mezzotype plates, illustrating corals, scenery, pearls, mother-of-pearl shells, fishes found about the reef, etc., the whole including many subjects. A considerable portion is devoted to the Beche-de-Mer fisheries conducted for the Chinese market. Besides the above beautiful plates, 16 superbly executed chromo plates are given showing anemones, corals, and other examples of the reef life. The text is exceedingly interesting. It is not a dry description of the place by any means, but tells the whole story of the reef and reads i many places as interestingly and graphically as any book of travel. A very full index is provided. It has been regretted that the work is absolutely undated, thus impairing its value as a reference in some cases which may arise regarding priority of description of similar points. The work possesses the feature of interesting the layman as well as the naturalist, appealing to the artistic and literary instinct as well as to the biological faculties.

DIE DEFINIZIONEN UND FUNDAMENTALSATZE der Theorie des Gleichgewichtes schwimmender Koerper. By Professor Victor Lutschaunig. 1893. Trieste: F. H. Schimpff. 66 pages, 10 plates.

This little volume treats on the stability of floating bodies and forms a critical review of the at present accepted theory of the stability of marine vessels.

PIETRO GHISLERI. By F. Marion Crawford. 1893. New York and London: Macmillan & Co. Pp. 429. Price $1.

A first-class psychological novel. The plot and the unfolding of characters are somewhat after the manner of Dr. Hammond. In each successive novel Crawford's power of portraying the subtleties of character increases, and he now ranks with Bourget in his grasp of character and falls little below Zola. The treatment of the poisoning episode is masterly and the whole novel shows that the *fin de siecle* writers must bring to their aid the knowledge of both the doctor and the lawyer if they wish to hold their readers.

PRACTICAL DESIGNING. A hand book on the preparation of working drawings. Edited by Gleeson White. Contributors: Alexander Millar, Arthur Silver, Wilton P. Rix, Owen Carter, R. Ll. B. Rathbone, Selwyn Image, H. Orrinsmith, George C. Hainte. 1893. London and New York: George Bell & Sons. Pp. viii, 327. Price $2.50. No index.

This very pretty work, well within the aspects of the present day, is really a collection of eleven monographs, on such subjects as carpet designing, pottery, metal work, bookbinding, and wall papers, each monograph by a recognized authority. Profuse illustrations are given to elucidate the text. It certainly seems as if the subjects represented by eleven typical classes of designing cover the subject pretty thoroughly. The absence of an index is to be regretted.

SOME HINTS ON LEARNING TO DRAW. By G. W. Caldwell Hutchinson, Art Master, Clifton College. 1893. London and New York: Macmillan & Co. Pp. xii, 199. Price $2.25.

It seems as though too much praise can hardly be awarded to this book and to the methods of treatment adopted in it. It is emphatically a book of drawing written up to the present date, characterized by the use of mathematical perspective combined with the most modern methods and theories. When it is stated that among the illustrators no less than 17 eminent artists are represented, and that the work of these artists represents but a minor portion of the illustrations, some idea of its character may be gathered.

DIE DYNAMOELEKTRISCHEN MASCHINEN. Ihre Geschichte, Grundlagen, Construction und Anwendungen. Sechste ganzlich neubearbeitete Auflage. Von Dr. F. Auerbach, Professor an der Universitat Jena. Pp. xvi, 288. No. index. Price $1.

DIE ELEKTRISCHEN LEITUNGEN UND IHRE ANLAGE FUR ALLE ZWECKE DER PRAXIS. Von J. Zacharias. Pp. xvi, 247. Price $1.

THE COLUMBUS GALLERY. Historical description. By Nestor Ponce de Leon. Illustrated. 1893. New York: N. Ponce de Leon. Pp. iv, 178.

This work gives reproductions of famous portraits and pictures connected with the great discoverer, with descriptive text. The latter not only gives an account of the 95 cuts, but includes notes upon many other pictures not illustrated. Thus a considerable value attaches to the book as a sort of catalogue of Columbus pictures in all parts of the world. Otherwise it is of high interest as being written in popular and anecdotal style. It should receive adequate welcome in these days of Columbian celebration.

THE METASPERMÆ OF THE MINNESOTA VALLEY. A list of the higher seed-producing plants indigenous to the drainage basin of the Minnesota River. By Conway Macmillan. Reports of the geological and natural history survey of Minnesota. December 29. 1892. Minneapolis, Minn. Pp. xiii, 826.

REPORTS OF THE UNITED STATES COMMISSIONERS TO THE UNIVERSAL EXPOSITION OF 1889 AT PARIS. Volume V. Agriculture. Edited by C. V. Riley, Ph.D. 1891. Washington: Department of Agriculture. Government Printing Office. 8vo. Pp. 935, 219 illustrations, 77 plates.

The exhibit made by the United States at Paris was very fine and the present volume, which contains a full description of the agricultural exhibits both of the United States and foreign countries, reflects great credit upon both the editor and the contributors. The work includes papers relating to vine cultivation, wine making, useful and injurious insects, including the dreaded phylloxera, field trials of implements, agricultural stations, food adulteration, the cultivation of textile fibers, vegetable oils, etc. The last chapter contains an excellent report by A. C. True, entitled "A Report on the History and Present Condition of Agricultural Science and Education in the United States."

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SCIENTIFIC AMERICAN BUILDING EDITION.

JULY, 1893.—(No. 93.)

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1. Elegant plate in colors, showing the handsome residence of S. E. Walton, Esq., at Springfield, Mass., at a cost of $10,000 complete. Floor plans and perspective elevations. A pleasing design.
2. Plate in colors showing the residence of Wm. H. Fitzgerald at Bridgeport, Conn., erected at a cost of $6,000 complete. Two perspective views and floor plans. J. W. Northrop, Esq., architect, Bridgeport, Conn. An attractive design.
3. A dwelling recently erected at Chester Hill, N. Y. Perspective view and floor plans. A model design. Cost $6,850 complete. Messrs. Mu n & Co., New York City.
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5. Engraving and floor plans of two designs of cottages recently erected for Mr. D. H. McKay, at Boston, Mass., at a cost of about $1,600. A. W. Pease, architect, Boston, Mass.
6. Floor plans and engravings of a stone residence erected for George W. Childs, Esq., at St. David, Pa. A very attractive design. Cost $7,600 complete. Messrs. F. L. & W. L. Price, architects, Philadelphia, Pa.
7. An old colonial style dwelling at Belle Haven, Conn. Floor plans and prospective elevations. A picturesque design.
8. A residence at Belle Haven, Conn. A unique design. Perspective elevation and floor plans. Messrs. Boring, Tilton & Mellin, architects, New York City.
9. Bird's-eye view of the World's Columbian Exposition —looking West.
10. The Fifth Avenue Theater, New York.—View showing the orchestra chairs and seating arrangement. Mr. Francis H. Kimball, architect, New York.
11. Miscellaneous contents: A change in name.—A tufted metal ceiling, illustrated.—Hanlon's automatic boiler feed, illustrated.—Simple means of raising water to house tanks, illustrated.—Copper statue, "Flying Dutchman," at the Columbian Exposition, illustrated.—Naphthalene as a timber preservative.—Ornamental parquetry floors and borders, illustrated.—An improved wood working machine, illustrated.

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The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4; Munn & Co., publishers, 361 Broadway, N. Y.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(5231) A. J. D. says: I have a lot of small steel and iron strips which I wish to plate with tin by dipping in the molten metal. I use the following process, but am only partially successful: Allow the strips to remain in a strong solution of sulphuric acid for a few minutes, to remove grease, scale, etc., then rinse in clear water, and dip in a solution of muriate of ammonia, for a flux. The tin adheres very well, but remains lumpy and uneven. Will you please inform me wherein the trouble lies and how I can remedy it? A. We advise a partial polishing of the articles after the scale has been removed. Then dip in hot strong caustic soda water to clean. Wash in hot water, and dip in muriate of zinc and ammonia.

(5232) F. O. J. says: There is a bad echo in the Baptist church here. The audience room is 38×50 feet inside, with a ceiling 21 feet from the floor. About 4 feet of the sides and 6 feet of the ceiling is taken up by a rounding corner, so that the ceiling proper is only 26×38. The pulpit is at one end of the room and slightly raised. Can this echo be destroyed by stringing wires near the ceiling? If so, kindly indicate the manner. Can wire fine enough to be practically invisible be used? A. The hanging of wires and wire netting closely to ceilings and walls is said to entirely prevent echo. Such arrangement cannot be made invisible, but may be so arranged with fine wire netting put up in panels with rosettes or moulding strips as to be ornamental.

(5233) J. R. M. says: Please inform me through your column of Notes and Queries if there is any use for hardened copper or brass in the arts or sciences. Enough call that is to make it worth one's while to work for it? A. There is an increasing demand for hard copper and brass. The Eureka Tempered Copper Co., Northeast, Pa., are now making hardened copper. There is plenty of room for new efforts in the production of hard copper and brass for frictional purposes.

(5234) T. C. B. asks: What amount of power can be gained from 1 inch of water running from a reservoir or barrel of 50 gallons capacity with a pressure of 6 feet? And what wheel is the best and most powerful, in this case? A. If a miner's inch is the measure, you will have $\frac{11}{1000}$ of a horse power under 6 feet head and the 50 gallons would last about 4½ minutes. A small impact wheel of the Pelton type would give the best economy.

(5235) G. B. says: I have a friend that has a small shop thoroughly equipped for manufacturing small machinery. He has hard struggling to get enough to do, yet is a good workman. I thought if you could tell me how I could make small cheap fans that could be regulated in speed and operated by a battery, that could be easily attached to the head of a bedstead or any part of a room, and the battery and fan could be made and sold for about $1 or $1.50, I think he could obtain sufficient orders to help him out. Or is there anything you would be willing to suggest? A. Fans such as you describe are made by electrical goods manufacturers and largely in use. Doubtful if your friend can make them for twice the figure you name. He might buy one and make a trial. We cannot suggest what would be best to manufacture. Knowledge of what is on the market and prices is necessary as a preliminary to selection.

(5236) E. L. asks: What percentage of nourishment or nutriment is there in rice of the best quality? A. The analysis of rice is given as follows:

Nitrogenous matter	6·94
Fat	0·51
Starch	77·61
Woody fiber	0·08
Ash	0·45
Water	14·41
Total nutriment	85·06

(5237) G. P. asks: Will you please inform me of a good preparation to put on knives, guns, etc., to prevent them from rusting? I have several fine instruments that I find are hard to keep from rusting. I have given several preparations a trial, but find them ineffective. Please inform me of a good preparation. A. We find nothing better than wiping the instruments often with a cloth and vaseline.

(5238) D. S. P. asks: What is the usual pressure per square inch in the boilers of the three following engines: The decapod on the U. P. R.R., the ordinary eight-wheeled American passenger engine, and the engine on the New York Elevated Railroad. A. The engines drawing the high speed trains on our principle railways are now carrying from 150 to 175 pounds pressure per square inch. The elevated road engines run with varying pressure from 100 to 125 pounds.

(5239) R. I. W. asks: Would it not do to wind both the armature and field magnets of motor described in "Experimental Science," pages 497 to 509, with No. 18 silk-covered copper wire? A. Yes.

(5240) E. H. J., Mich., says: A few years ago, large flights of wild pigeons were to be seen, in the spring and autumn, in almost all of the Northern States. For nearly fifteen years, few flocks of these birds have been seen in the central or southern part of Michigan, and I have been informed that few are now seen anywhere in their old places of resort. Will some of your readers tell us what has become of these birds, which once far excelled in number every other species in America? A. The advance in population, the destruction of our forests and the indiscriminate slaughter of the pigeons during their roosting season is no doubt the cause of their scarcity at the present time.

(5241) O. C. W. asks: Can you suggest a way of painting or otherwise making opaque one-half of a lantern globe so that that part of the globe will act as a reflector? A. A reflector can be made on the outside surface of one-half of the lantern globe by depositing a coating of silver from its solution, as is largely used in silvering looking glasses. The process is a rather delicate one and described at length on pages 502 and 503, in the "Scientific American Cyclopedia of Receipts," $5, mailed.

(5242) R. R. Snowden says: I inclose an insect which is remarkable as being the first of the kind I have ever seen, though I have closely observed insect life in North and South Carolina and Florida since the late war. It seems that insects new to this part of the country are occasionally making their appearance. For instance, the electric bug was never seen here before the introduction of the electric light. So also the orange tree has several new enemies. Please give some light on the specimen sent. A. Reply by Professor C. V. Riley.—The specimen sent by Mr. Snowden is an interesting although not uncommon species known as the glassy-winged sharpshooter (*Homalodisca coagulata*). It is found all through the Southern States and is responsible for a rather common injury to young cotton bolls in portions of Louisiana and Mississippi. This damage is particularly noticeable where the cotton fields are bordered by streams edged with young growth of cottonwood. The first generation of the sharpshooters lives upon the cottonwood and the second migrates to the cotton plants. They puncture the young bolls, making a fine hole like a bullet hole, from which in part comes the popular name of sharpshooter. They have been found also in Georgia upon the LeConte pear, in Texas upon the mulberry, in South Carolina upon asparagus, and in Florida upon oranges, but they do no marked damage to any of these crops. The nearly full grown and adult insects have a curious habit, in common with their near allies, of ejecting from the anus a considerable quantity of very clear liquid honey dew. The drops are thrown out with considerable force and to quite a distance, and when the insects are abundant they produce the phenomenon known as "weeping trees." A full account of this species, with illustrations, will be found in *Insect Life*, vol. v., pp. 150-154.

(5243) J. T. S.—Reply by Professor C. V. Riley.—This large click beetle or snapping beetle is known in the books as *Alaus oculatus*, and is the largest of the click beetles found in North America. The large eye-like spots on the thorax are not the true eyes, which will be found on either side of the head and which are in reality small compared with the spots. When placed upon its back it will spring to a height of 2 or 3 inches in its efforts to resume its proper position. The larva of this beetle is a hard, yellowish brown, elongate worm, with dark brown spines at the anal end. It is found in burrows in various trees, especially those which are dead and decayed, and is supposed to feed on the dead wood. There is good reason for believing, however, that it is also predaceous and feeds on other wood-boring larvae.

(5244) S. H. B. says: 1. An outdoor bell circuit contains about 800 feet of wire and an electric bell, and is supplied with 6 cells of carbon battery (sal ammoniac solution). The bell, in short circuit with two cells of battery, rings satisfactorily, but the six cells will hardly cause a tremor in the hammer of the bell, when working over the whole line. The line being O. K., would the addition of two (say) cells of battery cause the bell to ring properly, or would it be necessary to double or triple the number of cells at present used, to cause the bell to work two or three times as strongly? A. The failure of your bell is due to the lack of E.M.F. The resistance of the wire leading to the bell is so great as to use up a large proportion of the energy of the current. If you do not care to put up a line of less resistance, the only remedy is an increase in the number of cells. Without knowing the resistance of the bell and of the line, we cannot say how many cells will be required. 2. What is the probable voltage of an ordinary plain carbon battery (microphone, Samson, Ideal, etc., as named by makers)? A. About 1½ volts per cell. 3. Will you kindly tell me of a book which will be of assistance in such matters? My books are purely theoretical and behind the times. A. For general information we would recommend "Experimental Science;" for specific information on bell hanging we refer you to "The Construction of Electric Bells," by F. C. Alsop, price $1.25; "Electric Bells and All About Them," by S. R. Bottone, price 50 cents; "Bell Hangers' Hand Book," by F. D. Badt, price $1.

(5245) K. A. F.—Reply by Professor C. V. Riley.—The insect sent by Mr. Fichthorn is the common apple plant louse (*Aphis mali*). It is usually abundant and injurious in the early part of the summer and may be destroyed by spraying with a dilute kerosene soap emulsion prepared in the following manner: Take two parts kerosene oil and one part strong soapsuds and agitate violently by churning or by passing the liquid back and forth through a force pump into a bucket until a thick, butterlike emulsion is formed. Dilute one part of this emulsion with fifteen parts of water and spray. The life history of this, as of so many other species of aphis, is extremely interesting, and unrecorded observations would indicate that after a series of parthenogenetic generations are produced upon the apple in the early part of the season, the insects migrate in the winged female form and propagate on the roots of certain grasses during the heat of the season. In the autumn the return migrant revisits the apple, and in due time the sexes are produced and the perfect female fastens her eggs, sometimes in very great numbers, upon the terminal twigs and buds. These, at first greenish, become glossy black and carry the species over the winter. The eggs are not easily killed and the best season to spray is soon after hatching in spring.

(5246) W. S. P. asks (1) how to clean brass and German silver after hard soldering. A. Boil the soldered articles in a weak acid solution, 1 part sulphuric acid, 5 parts water. 2. Is there any toxic substance that will kill willow, maple, or fruit trees by making a small hole in the trunk and putting the substance into it? A. An injection of creosote will kill trees. 3. Is there a solder that will fuse at about 700° or 800° Fah., that will solder brass, German silver, etc.? A. Zinc or tin alloyed with a small portion of copper will make a solder for varying temperatures from 500° to 1,000° Fah. Try an alloy of 5 to 10 per cent of copper in the total quantity. The zinc and copper solder will be somewhat brittle. The tin and copper will be tough.

(5247) J. H. N. says: In the SCIENTIFIC AMERICAN about a year ago attention was called to the need of a safety petroleum lamp, as a suggestion to inventors. Could you give the necessary qualifications to be filled in a safety lamp and state if there is a premium offered for it? A. The most essential feature needed is to so construct a lamp in which there can be no admixture of air with the vapor of the oil within the lamp to cause explosion or to so close the communication between the flame and the air space in the lamp that the air-saturated vapor cannot reach the flame, nor by overheat to allow an undue capillarity in the wick, which sometimes overflows and takes fire below the top of the wick tubes. There is no premium offered for a safety lamp.

(5248) T. D. B., Jr., asks: What diameter, pitch, and speed screw should I use on an 18 foot St. Lawrence skiff to consume one-fourth horse power? What speed should the boat make? A. The screw should be 12 inches diameter, 24 inch pitch and make 200 revolutions per minute for a speed of 3 or possibly 4 miles per hour.

TO INVENTORS.

An experience of forty-four years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.

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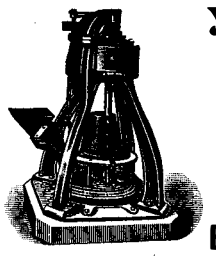

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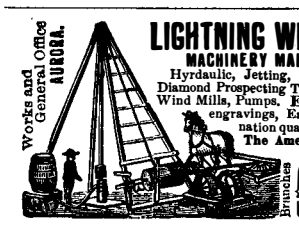

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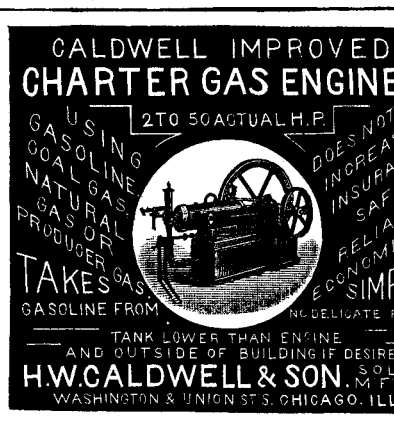
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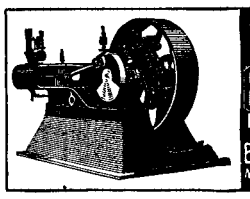

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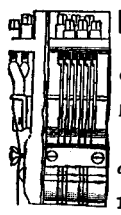

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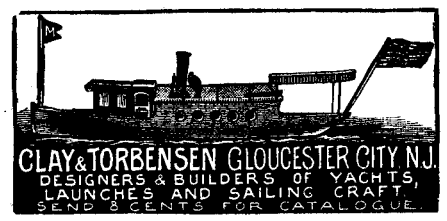

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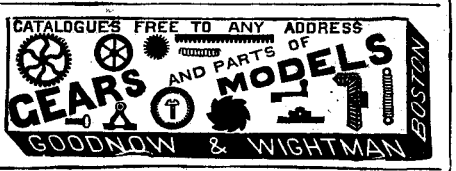

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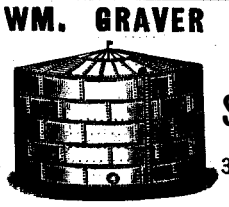

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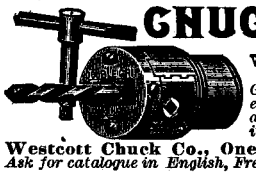

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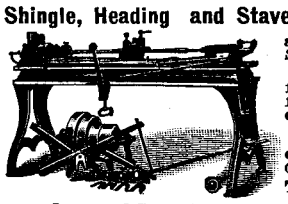

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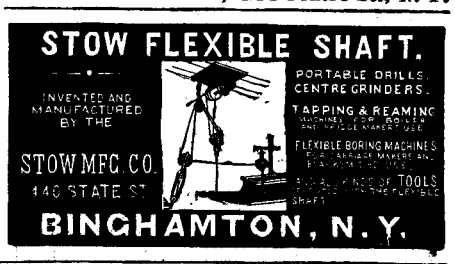

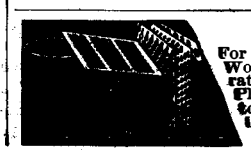

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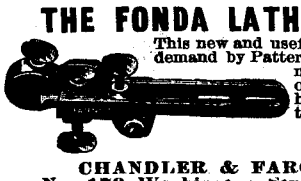

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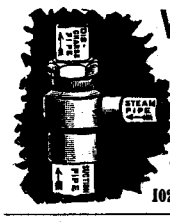

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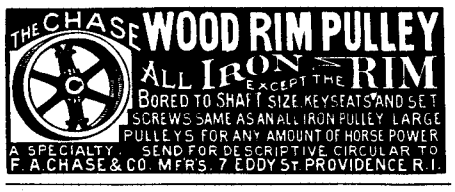
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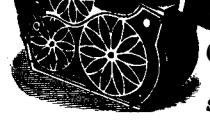

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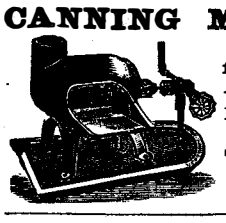

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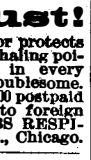

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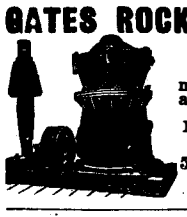

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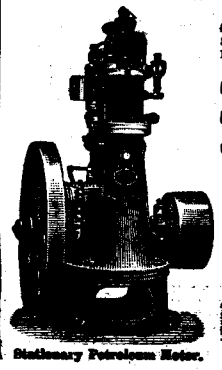
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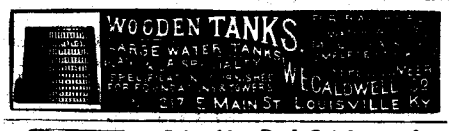

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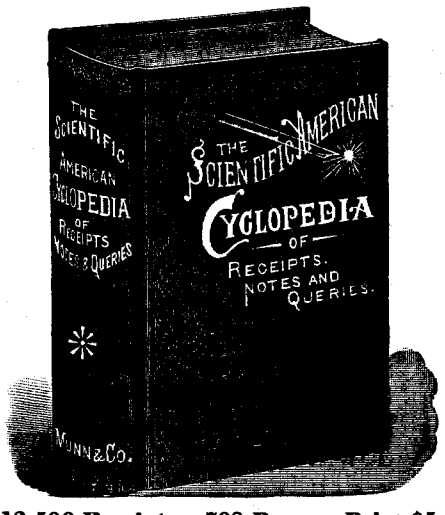

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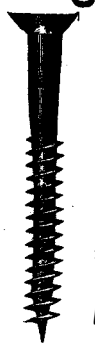

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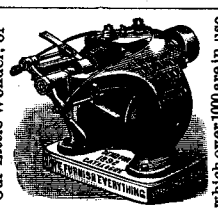

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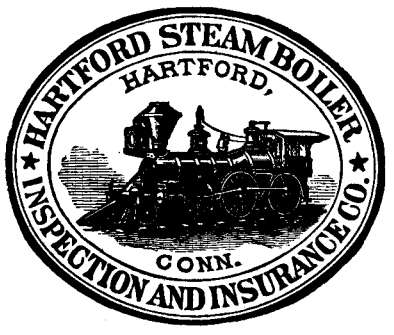

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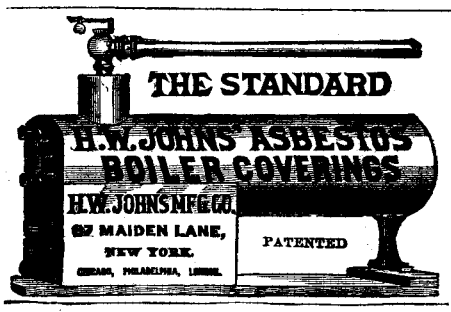

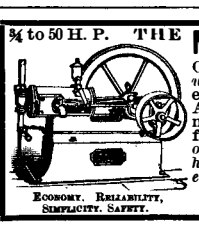

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